

Bausch & Lomb Optical Co.



Projection
Apparatus







Works of the Bausch & Lomb Optical Co., Rochester, N. Y.

Balopticons and Accessories

Apparatus for Every Known Form of Optical Projection,
Including Most Complete and Diversified Methods
for Scientific Demonstrations



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Bausch & Lomb Optical Co.

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We maintain branch offices in New York, Chicago, Washington and San Francisco, where sample lines of our products are carried for the inspection of our customers. Our representatives will be found well versed in all the phases of our business, glad to extend every courtesy and to give any desired information.

Our products are supplied also by dealers in the United States and Canada and by agents in foreign countries.

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BAUSCH & LOMB OPTICAL CO.
EXECUTIVE OFFICE AND MANUFACTORY
ROCHESTER, N. Y.



Preface

THE position of optical projection in education, as well as for general entertainment purposes, has become thoroughly established. Its value in both advanced and elementary work is now so widely recognized that the institution is not considered fully equipped, which does not possess enough high grade projection outfits to meet the varying needs of its different departments.

At the same time the projection lantern is more popular than ever before in the church, Y. M. C. A., lodge and home. Its usefulness in all of these fields has increased with the practical development of its different forms and applications. That we have played a leading role in this development is evidenced by the **Grand Prix** awarded our line of projection apparatus, for excellence of construction and originality of design, at the Panama-Pacific Exposition.

The trade name "Balopticon", by which we designate our lanterns, is a word in common use among those interested in the highest grade projection apparatus. The prefix, "Bal", is derived from the Greek verb, "ballein", meaning to throw or project. Incidentally it contains the initials of our company and is rightfully used only by us.

This new edition of our projection catalog we believe to be the most complete ever published, for in it we present what we consider the most comprehensive projection line ever placed on the market. The user of projection apparatus will also find in the following pages much information of interest and value regarding the various possibilities and applications of optical projection. Special attention is called to the following noteworthy features:

**New, Simplified, Double Dissolving Balopticon,
Improvements in Projection of Opaque Objects, Especially with
Alternating Current,
Application of Gas-Filled Mazda Lamps,
Improvements in Microscopical Projection,
New Balo Projection Lenses,
Projection of the Spectrum,
Convertible Balopticon for All Known Forms of Projection,
New Combined Balopticon with 1000-Watt Mazda Lamp,
Home Balopticon for Opaque Objects and Lantern Slides,
Balopticon for Large Opaque Objects.**

Back of our projection apparatus, as all of our products, are more than sixty years of scientific and productive experience as optical manufacturers. The different instruments offered are results of the combined efforts of our Scientific and Technical Bureaus, working frequently in co-operation with the users of such apparatus, whose suggestions are always given serious attention.

In the actual manufacture of our projection apparatus we enjoy the advantage of producing practically all parts—mechanical as well as optical—in our own works. This enables us not only to assure the effective co-ordination of the different parts, but to give all of our Balopticons and accessories the unqualified guarantee which our name conveys.

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Terms

WHEN ordering from this catalog please give catalog number, the name of article and size (when necessary). For telegraph orders use code words.

Our prices are f. o. b. Rochester, N. Y. Transportation on goods sent on memorandum, or for examination, is at the expense of the customer.

Satisfactory references are required to open accounts, otherwise remittances in cash, postal orders, or New York or Chicago current funds should accompany the order. If local check is more convenient, $\frac{3}{8}$ of 1% (on amounts less than \$100.00, 10c) should be added to cover bank exchange.

Goods sent on approval and returned in damaged condition will be repaired at the customer's expense. Goods made on special order will not be sent C. O. D. nor on memorandum. Goods returned for any reason should be plainly tagged with the sender's name and address.

Goods ordered to be sent by mail are at purchaser's risk and expense. Postage should be forwarded with cash orders, otherwise we shall ship express collect.

No charge is made for packing. Unless otherwise specified we shall use our best judgment in the mode of shipping, prepaying transportation if desired. Our responsibility ceases when we have delivered the package to the common carriers and have received their receipt. All claims for breakage should be reported to the transportation companies at once. Please examine all packing minutely for small items.

We exercise the utmost care in manufacturing and packing; in case faulty goods inadvertently reach our customers, we shall feel under obligation if our attention is called thereto.

The prices in this catalog are subject to change without notice.

BAUSCH & LOMB OPTICAL CO.

Introductory

Optical Projection and Its
Various Applications

Optical Projection

Although unappreciated and undeveloped for generations, optical projection has come into its own at last. It is to-day an agency of widely recognized value in the scientific and educational world and in many other fields of usefulness.

In Education

Starting in the institutions of higher learning the projection lantern has come into very general use in high schools and grammar schools in many branches of instruction. Its serious recognition by educators is apparent in the fact that the New York State Educational Department has organized a Department of Visual Instruction, possessing a collection of more than 300,000 slides which may be obtained free of cost by schools under the Department. Movements are on foot in other states looking to similar ends.

In Church, Lodge and Home

A large number of churches and Sunday schools now possess projection outfits for the double purpose of instruction and entertainment. The interest and value of Sunday evening addresses and Bible lessons are greatly enhanced by projected views. Lodges and fraternal organizations, too, are coming to use the lantern extensively in their ritualistic work. Always popular in the home as an entertainer, it now has a stronger hold there than ever before by virtue of the really high grade apparatus which can be produced at a moderate cost.

Supplement to Camera

Many camera clubs and individual enthusiasts are numbered among our patrons. The projection lantern renders a two-fold service here. It enables the individual to reproduce specimens of his art most effectively, while clubs find it an invaluable aid in the study and discussion of photographic processes.

Historical Resumé

While optical projection in this scientific and universal application is of comparatively recent development, the basic principles have been known and exemplified in various primitive forms of apparatus for several centuries. In many Latin writings between the years 1500 and 1700 we find the projection lantern described as the "camera obscura" or "laterna magica". Who the inventor was seems to be unknown. The achievement has been variously ascribed to Bacon, Porta, Dechales, Kircher and other authors who have handed it down in literature to succeeding generations.

This impression is erroneous, however. None of these writers has claimed the distinction, and all have written as though treating facts and principles which, even at that early period, had been established for some time. It is quite probable that several different experimenters in light and optics devised crude lanterns independently of each other.

Work of "Wizards"

Those pioneers in the field were regarded for the most part as wizards, and the primitive outfits which they fathered excited curiosity, mingled with awe, and little more. Optical projection occupied scarcely any stronger position during the intervening centuries down to comparatively modern times.

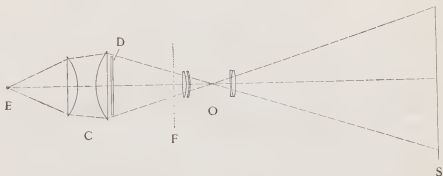
Euler, the great Swiss mathematician, recognized its possibilities more than a century ago but was prevented from developing them by an utter lack of efficient illuminants. Sunlight was about the only form which was sufficiently bright, and that was impracticable for projection purposes. Thus the modern achievements already alluded to may be attributed to the development of illuminants as well as optics.

Six Different Applications

There are six applications of optical projection available to-day—projection of lantern slides, of opaque objects, of microscopic objects, of horizontally placed objects by transmitted light, projection with polarized light and projection of the spectrum. In our various equipments we provide for all six of these applications in a thoroughly practical and efficient manner.

Lantern Slide Projection

This is the primary form of projection. It is effected by sending light from a suitable source through a set of condensing lenses, which serve to direct the rays in even distribution through every part of the transparent glass slide bearing the object to be projected and then through the projection lens, or objective, which casts the enlarged image on the screen.

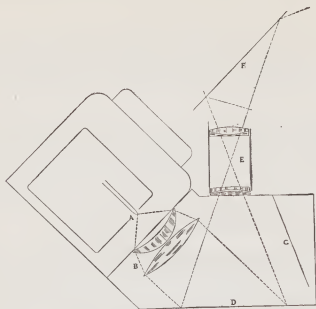


Path of Light in Lantern Slide Projection.

The arrangement of parts is indicated in the accompanying diagram, in which E is the illuminant, C the condensing system, D the slide, O the diaphragm plane of the objective, or projection lens, and S the screen.

Projection of Opaque Objects

The projection of opaque objects, such as post cards, photographs, book illustrations, type matter, maps, drawings and even solid objects, is one of the latest forms of projection to be developed to a truly high standard of efficiency. It has become very popular, however, among educators and all users of projection, since an almost unlimited amount of illustrative material is thus rendered immediately available for the purpose at a very low cost.



Path of Light in Projection of Opaque Objects.

Difficulties Involved This form of projection is based on the principle of reflection, as indicated by the accompanying diagram, in which **A** is the illuminant, **B** condensing lenses, **D** the opaque object to be projected, **E** the projection lens and **F** a mirror to direct the image to the screen in correct position. The fewest reflections possible are thus shown to be two, if one wishes to produce a picture on the screen in its true position, that is with reading matter, for instance, unreversed from left to right. One of these two reflections must be from the object itself, which at best is a poor reflecting medium. When it is further considered that in the projection of opaque objects the direction of the beam of light is altered and considerably dispersed, so that a smaller percentage of light rays reaches the projection lens than in the case of lantern slide projection, it is obvious that the screen image so obtained cannot equal in brilliancy that produced from a lantern slide, providing lens equipment and illuminant are the same.

Means Employed To overcome these handicaps we employ a projection lens of large diameter (4 inches or more) and a more intense light. The diameter of the lens in this form of projection is a very important consideration, since, all other things being equal, the illumination will vary inversely as the square of the diameter of the lens being used.

Next in importance to the aperture, or illuminating value, of a lens is the quality of correction for definition and flatness of field, and the larger the diameter for a given focal length, the more complex becomes its correction. It follows, then, that lenses used for the projection of opaque objects on our higher priced Balopticons are necessarily of an exceptionally high grade, because of the very flat field they give in spite of their large diameter.

Projection Distances Because of the large area usually covered in the projection of opaque objects, as compared with that of lantern slides, it is necessary to use lenses of two or more times the focal length of those used for lantern slides, in order to obtain images of the same size from both slides and opaque objects (see tables, page 18).

In order to obtain satisfactory illumination, we consider it necessary to maintain the ratio between the aperture and the focal length of the lens at about 1 to 4 or 5. Hence there are limits of focal length, beyond which, for optical reasons, we cannot go. Therefore, it is not practical to attempt the projection of opaque objects at the extremely long distances at which lantern slide projection may be satisfactorily undertaken.

Required Conditions To accomplish really satisfactory results it is necessary to have a totally darkened room and a good quality of screen, one with either a white opaque or an aluminum coating. Except in the case of the Home Balopticon, intended for use at short projection distances, the only illuminants we recommend for the projection of opaque objects are the arc lamp, using from 25 to 35 amperes of current, and the 1000-watt, gas-filled stereopticon Mazda lamp.

Microscopical Projection

This form of projection has become a very useful agency in the sciences, in class room and general demonstration work. An efficient projection microscope is of great value in supplementing table work with individual instruments. With it an instructor can demonstrate to all the members of a class simultaneously objects which are not available for individual examination. He finds it a great convenience, too, when he wishes to explain a slide to the class as a whole or to present a specimen quickly for comparison and discussion by members of the class, also in reviewing past work or assigning work in advance. Illustrated lectures on microscopical subjects are rendered possible, time is saved and the students' interest is stimulated.

Its Early Origin Optically considered a projection microscope is a projection lantern with an objective of short focus for displaying very small objects greatly enlarged. Historically it dates back nearly as far as the "laterna magica" itself. We find the latter used as a projection microscope as early as 1665. Fahrenheit, inventor of the thermometer bearing his name, devised a projection microscope before the year 1736 and exhibited it in Amsterdam.

Among those who saw this instrument of Fahrenheit's was Lieberkühn, the anatomist, who was greatly interested in it as an aid in his work. He accordingly had one made and took it with him to England, where it aroused considerable interest. Thus it came about that Lieberkühn was wrongfully regarded as the inventor, although he never claimed the honor.

The projection microscope was quite widely used throughout Europe by the middle of the 18th century, although, of course, in a very crude form. Both sunlight and lamplight were used as illuminants, and the optical and mechanical devices were of a primitive nature.

The scientific endeavor which finally led to the present high development of this instrument was concerned with the improvement of illuminating devices, as well as optics and mechanical appliances for operating the instrument. The compound projection microscopes, which we offer to-day, are as high grade scientific instruments in every respect as any regular table microscope and provide possibilities not to be had in regular microscopes.

While some may have experienced a feeling of doubt in the past as to the real efficiency of microscopical projection, they may now rest assured of obtaining absolute satisfaction with any of our higher grade outfits, especially designed for this kind of work. One of the latest developments in microscopical projection we offer in our **combined horizontal and vertical type** of microscope, which provides for the projection of microscopic objects held in a horizontal plane as well as in the usual manner.

The small diameter of the microscope objectives and the high magnifications which they produce require **intense and uniform illumination** of the slide or object to be projected. To accomplish this we have adapted the scheme originally introduced by Köhler, which consists of projecting the evenly illuminated image of a condensing lens into the object slide by means of a substage condenser.

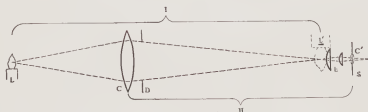


Figure I—Köhler Illuminating System.

The arrangement is shown in the accompanying diagram. It consists of a light source, *L*, a single condensing lens of suitable focus, *C*, a diaphragm, *D*, a substage condenser, *E*, with an object slide, *S*. The condenser, *C*, forms an inverted image of the light source, *L*, at *L'*, or the plane of the iris diaphragm of the substage condenser, *E*. The substage condenser is so placed that it focuses the image of the first condenser, *C*, in the plane of the object, giving *C'*. The size of the illuminated aperture is regulated by the diaphragm, *D*, of the condenser, which diaphragm is imaged by the substage condenser in the plane of the object slide at a point nearly coincident with *C'*, giving a sharply defined margin of the projected image.

The Köhler illuminating system is made use of, without modification, in our Simplified Micro-Projection Apparatus. (See page 83).

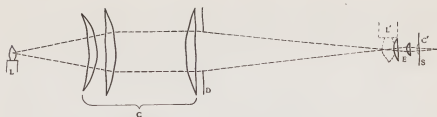


Figure 2—Application of Köhler Illuminating System to Model D Balopticon.

Our Illuminating Systems

In adapting this illuminating scheme to our model D Balopticon we have substituted for the single condensing lens, C in Figure 1, our triple condensing system (see Figure 2). This change of condensers was made to enable a quick interchange between microscopical and lantern slide projection. We furnish a substage condenser of a suitable numerical aperture and optical construction to meet the special requirements. The regular Abbe condenser is not suited to this purpose because of its short focal length.

In the case of our Universal Balopticon the large projection lens for opaque objects, supplemented by a special condensing lens, is substituted for the front lens of the triple condensing system.



Figure 3—Application of Köhler Illuminating System to Convertible Balopticon.

Still another adaptation of the Köhler system is now used to give the exceptional results possible with the Convertible Balopticon, especially in higher power work. The path of light is shown in Figure 3.

To obtain this the condensing lens directly back of the lantern slide carrier, which lens is mounted in a swinging arm, is thrown out of the optical axis, and a small double convex lens, mounted in the dark chamber, is swung into position directly in front of the large rear condensers. This produces a gradually converging pencil of light, which finally forms a large image of the arc at the diaphragm plane of the substage condensers and fully fills the aperture of the high power condenser. With the improved substage condensers this arrangement is used for all the different powers of objectives that may be required.

Table of Magnifications

An important consideration in selecting apparatus for microscopical work is the optical equipment required to obtain the desired magnifications. The following table will be found of value. It gives the approximate magnifications obtained at different projection distances with the objective alone and with the objective combined with our 3× or our 5× projection eyepieces (see "Accessories"). The projection distances given are

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those at which microscopical work is most commonly carried on in the lecture room and are measured from the objective to the screen.

| Objectives in Terms of Focus | Optical Arrangement | Projection Distance | | | |
|------------------------------|---------------------|---------------------|--------|--------|--------|
| | | 10 ft. | 15 ft. | 20 ft. | 25 ft. |
| 72 mm | Objective alone | 40 | 65 | 85 | 105 |
| 48 mm | Objective alone | 65 | 100 | 130 | 165 |
| | With 5× eyepiece | 120 | 180 | 240 | 300 |
| 32 mm | Objective alone | 95 | 145 | 190 | 240 |
| | With 5× eyepiece | 240 | 360 | 480 | 600 |
| 16 mm | With 3× eyepiece | 410 | 615 | 820 | 1025 |
| | With 5× eyepiece | 595 | 895 | 1195 | 1495 |
| 8 mm | With 3× eyepiece | 850 | 1275 | 1700 | 2125 |
| | With 5× eyepiece | 1195 | 1795 | 2395 | 2995 |
| 4 mm | With 3× eyepiece | 1790 | 2685 | 3580 | 4475 |
| | With 5× eyepiece | 2575 | 3885 | 5160 | 6450 |

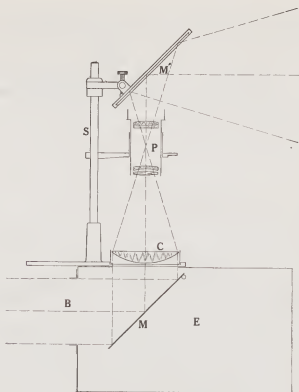
Mechanical Excellence Mechanically our projection microscopes have been equally well perfected. They are provided with adjustments, both coarse and fine, which are marked by careful workmanship and very accurate movements, so essential to satisfactory micro-projection.

Microscopical projection will be more effective if an aluminum screen is used, because of the greater brilliancy of the image thus afforded.

Projection of Horizontally Placed Objects by Transmitted Light

It is often desirable for certain physical, chemical and biological demonstrations to have the objects to be projected in a horizontal position. Among these may be mentioned such objects as a glass dish of iron filings set in commotion by a magnet or by vibrations of the air, as those caused by a pulsating violin string; also different animal organisms moving in water, or drooping plant formations.

To accomplish this we furnish a simple vertical attachment, the principle of which is apparent from the accompanying diagram. **B** is the beam of parallel light, which has come from the illuminant through the two rear lenses of our triple condensing system. It strikes the inclined mirror, **M**, in the dark chamber, **E**, and is reflected vertically through the plano-convex condensing lens, **C**, placed over the opening in the top of the dark chamber. The object to be projected is placed on the flat surface of the condensing lens, **C**, and the light rays focused by **C** in the projection lens, **P**, which is supported by the upright standard, **S**, image the object on the second inclined mirror, **M'**, which directs the image toward the screen.



Path of Light in Vertical Attachment.

For Large
Specimens

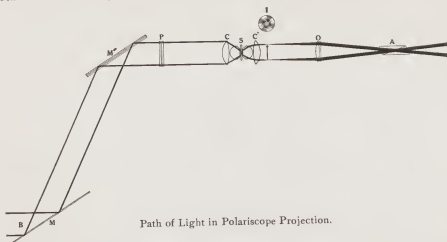
We have increased our facilities for projecting large objects placed horizontally by using the same principle for the construction of an especially large apparatus which enables one to project X-ray plates, brain sections or transparencies of eight inches or less in diameter, without first reducing them. This apparatus is designed for the Convertible Balopticon page (68) and is described and illustrated under that model.

Projection with Polarized Light

For general demonstrations with polarized light, in lectures on physics for instance, we recommend a **Projection Polariscope** which, being an adaptation of the apparatus first described by Delezenne, is really a Norrenberg apparatus with an additional mirror for the purpose of keeping the axis of the polarization apparatus parallel to the axis of projection.

The diagram illustrates the scheme as used with convergent light for the purpose of showing interference figures, etc. The light coming from the light source is made parallel by a triple condensing system and strikes the silvered glass mirror, *M*, under an angle of incidence of 57° . From there it is reflected under

the same angle to the mirror, M' , which stands parallel to M and reflects the beam in a direction parallel to the axis of the projection apparatus.



Path of Light in Polariscopes Projection.

The mirror, M' , is made of black glass and covered with two plane glass plates. The light becomes polarized by reflection from this mirror and passes through a pair of quarter-wave mica plates, P , one of which may be rotated so as to rotate the plane of polarization. It is then converged by the condenser, C , on the specimen, placed on the stage, S , so as to pass through the specimen under all angles.

The interference figure, I , is formed in the focal plane of the other lens system, C' , which is exactly like C and arranged symmetrically with respect to the object. The interference figure, as well as any micrometer scale, pointer, etc., which may be introduced at I , is imaged on the screen by the single achromatic lens, O . The analyzer prism, A , is placed between O and the screen at the point where the pencils cross.

For work in parallel polarized light the two lens systems, C and C' , are swung out.

Petrographical Projection with Microscope

For illustrating lectures on petrography, chemistry, etc., we offer for the first time a number of accessories, by means of which the projection microscope can be readily employed for projection with polarized light. These accessories can be added to our Large Projection Microscope only and are described under Projection Microscopes. (See "Accessories.")

For all projection with polarized light we recommend strongly the use of an aluminum screen.

Projection of the Spectrum

For the projection of **absorption spectra** we place upon the optical bed an adjustable slit, upon which the condenser forms an image of the light source. The slit thus illuminated is imaged on the screen by the projection lens.

The flint prism, or bottle prism with carbon bi-sulphide, (equilateral 60°) is placed on an adjustable table in front of the projection lens. If then the axis of the projection apparatus is given the proper inclination toward the screen, the sequence of colored images of the slit, which forms the spectrum, will appear on the screen.

For the projection of **emission spectra**, or for the projection of **complementary colors**, we offer special accessories accommodated on an accessory optical bed, which may be attached to the regular optical bed. This equipment is particularly effective, projecting an exceptionally bright and pure spectrum. These accessories are fully described and illustrated under Accessories (see index).

General Construction

There are several features to be noted in the general construction of our projection apparatus, which play an important part mechanically in achieving the high degree of efficiency sought. To obtain portability in our B and C types of construction, the standards are made of heavy sheet metal by special forming tools. This method greatly reduces the weight of the apparatus, and the standards equal castings in rigidity.

When the first Balopticon was designed with optical bed of the lathe type, there was adopted a certain size of bed, height of standard, etc., which has been adhered to in all instruments of this type, namely the Model D, Universal and Convertible, and their accessories, so that the same fittings and optical centers are insured upon all. This policy has resulted in securing that standardization of apparatus and interchangeability of parts which characterize our entire line of projection apparatus. When a Balopticon is equipped with optical bed, any standard carrying accessories, or any piece of apparatus provided with the necessary clamp, can be adjusted along the bed and the simple act of clamping secures the accessory in accurate optical alignment.

Our instruments are finished with a dull, black lacquer thoroughly baked in a high-temperature oven. This treatment produces a rich, black finish which is both serviceable and appropriate.

Illuminants

While a number of different illuminants may be utilized to supply the light for projection purposes, we confine our attentions almost entirely to the arc lamp and the new gas-filled, Mazda stereopticon lamp, where electricity is available, or to the acetylene burner, where electricity cannot be used.

Arc Lamp The arc lamp is a most satisfactory form of illuminant and for some kinds of projection, such as the projection of microscopical slides, of the spectrum and complementary colors—wherever, in fact, a very concentrated, homogeneous spot of light is required, it is the only light source we recommend.

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We use only the 90° type of arc lamp, i. e. with the carbons at right angles to each other, and most of our lamps are so mounted that one carbon (the positive in case of direct current) is in alignment with the optical axis of the apparatus. This is the only form of arc lamp that can be used where accurate centering is absolutely essential to satisfactory results, since it keeps the horizontal crater always in the optical axis, while with other styles of arc lamp the position of the crater with reference to the optical axis would be constantly shifting as the carbons burned away.

Arc lamps operate best on about 50 volts across the arc. Consequently it is necessary to use a resistance, or **rheostat**, in series with the arc to reduce the line voltage (either 110 or 220 volts) to that required.

**Gas-Filled
Mazda Lamps** Rapid strides in illuminating engineering have been made in another direction during the past year, with the result that the new gas-filled, Mazda stereopticon lamps with concentrated filament will replace the arc lamp in many Balopticons designed only for the projection of lantern slides and opaque objects, both on account of simplicity of operation and high degree of efficiency per amount of current consumed. This is particularly true where only alternating current is available, since an arc lamp (especially of high amperage) is not very satisfactory to operate on alternating current and is very low in efficiency compared to one operating on direct current.

These new Mazda lamps have an efficiency of from 0.8 watt per candle, in the lower wattage, to 0.55 in the higher. For either lantern slides or opaque objects they are far more effective than the alternating current arc lamp, using approximately one-third the amount of current to produce equal illumination. The Mazdas are, of course, entirely automatic and silent, burning with the steadiness that characterizes the ordinary incandescent lamp. Furthermore, the light is very pleasing to the eye and gives a very good rendition of color values.

These lamps are made in sizes from 250 up to 1,000 watts and are used with either a portion of the globe silvered or in conjunction with an optically corrected, glass reflector. The reflector is recommended because the unsilvered lamp is less expensive to renew. In order to secure the full efficiency of the reflector for lantern slide projection it should be set at a fixed point with reference to the filament and should be mounted to move with the lamp when adjusting the latter with reference to the condensers. See pp. 104-105.

The length of life of these lamps cannot be positively stated. They are very carefully made, however, of a much heavier filament than that used in the ordinary illuminating Mazda lamp and should give an average life, according to the manufacturer, of approximately 200 hours. Even with this as the maximum life of each lamp, however, it will be found upon investigation that the replacement of Mazda lamps is less expensive than the operation of an arc lamp, when the consumption of current and carbons is taken into consideration.

**Acetylene
Burner** The acetylene burner, while not equal to some other forms of non-electric illuminants, is nevertheless the form generally used, where electricity is not available. Its use has been rendered very convenient by the introduction of charged tanks of acetylene gas, such as

those used on automobiles and motorcycles for headlight illumination. These can be rented or exchanged at almost any automobile supply store. This illuminant is very popular among institute workers and others lecturing in rural districts, where electricity is not often available.

Oxyhydrogen Burner

The oxyhydrogen burner gives illumination exceeding in brilliancy that of the acetylene burner, but is not so convenient and costs somewhat more to operate. An oxyhydrogen generator is recommended as a source of supply.

Projection Lenses

Improvements on the optical parts of our Balopticons have been in keeping with the mechanical development, as evidenced by our new series of Balo projection lenses. These superior objectives are of an entirely new type of construction, particularly well corrected for **flatness of field** and **critical definition**. They are made in three series as described under "Accessories" (see index). These new lenses are now supplied on all but two of our Balopticon models.

Selection of Lenses

In purchasing an apparatus for the projection of either lantern slides or opaque objects a point which should receive careful attention is the selection of an outfit with the correct focal length of lens to meet the specific requirements satisfactorily. The focal length of the projection lens, all other conditions being equal, determines the size of picture on the screen. In selecting an apparatus, therefore, one should determine the distance at which the lantern is to be placed from the screen and the size of picture desired. With these two factors given, the focal length of lens required can readily be determined by reference to one of the tables here given.

We would particularly caution Balopticon users not to make the mistake, too often made when working with a projection lantern, of deciding upon too large a picture. Any picture out of proportion in size to the distance at which it is being viewed appears unnatural and lacking in perspective and is a strain to the eyes of the observer.

Another point to bear in mind is that the intensity of illumination per unit of area varies inversely as the square of the width of the picture; therefore, the smaller the picture the more brilliant it will be. On the other hand, the picture should be large enough, of course, to enable those seated at the farthest points from the screen to see all of its details without difficulty. A fairly safe rule to follow, according to Prof. S. H. Gage, of Cornell University, is to determine upon a picture equal in width to about $\frac{1}{4}$ or $\frac{1}{5}$ the distance from the screen to the farthest point at which it will be observed.

Projection Tables

Having thus established the two determining factors mentioned, one has only to refer to that table below which covers the kind of projection and the size of projected area offered by his apparatus. The focal lengths here tabulated are those which are listed with some one of our different Balopticons for either lantern slides or opaque objects. The

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tables give in feet the length of one side (the longer in the case of lantern slides) of the screen image to be obtained at the different projection distances and with the different lens foci indicated.

Table 1: For Lantern Slides, 2 3/4 x 3-inch Mat Opening

| Focus of Lens | Distance from Lantern to Screen | | | | | | | | | | |
|---------------|---------------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|
| | 15 ft. | 20 ft. | 25 ft. | 30 ft. | 35 ft. | 40 ft. | 45 ft. | 50 ft. | 60 ft. | 70 ft. | 80 ft. |
| 6-inch | 7 1/2 | 10 | 12 1/2 | | | | | | | | |
| 8-inch | 5 1/2 | 7 1/2 | 9 1/2 | 11 1/4 | 13 | 15 | | | | | |
| 10-inch | 4 3/4 | 6 | 7 3/4 | 9 | 10 1/2 | 12 | 13 1/2 | | | | |
| 12-inch | | 5 | 6 3/4 | 7 1/2 | 8 3/4 | 10 | 11 1/4 | 12 1/2 | 15 | | |
| 15-inch | | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 12 | 14 | 16 |
| 18-inch | | | | 5 | 5 3/4 | 6 1/2 | 7 1/2 | 8 1/4 | 10 | 11 1/2 | 13 1/2 |

Example:—A 10-inch lens used at a distance of 40 feet from the screen will project an image measuring 12 feet on its longer side.

Table 2: For Opaque Objects, 5 x 5-inch Opening

| Focus of Lens | Distance from Lantern to Screen | | | | | | |
|---------------|---------------------------------|--------|--------|--------|--------|--------|--------|
| | 15 ft. | 20 ft. | 25 ft. | 30 ft. | 35 ft. | 40 ft. | 45 ft. |
| 15-inch | 4 1/2 | 6 | 8 | 9 1/2 | 11 1/2 | 13 | |
| 18-inch | 4 | 5 1/2 | 6 1/2 | 8 | 9 1/2 | 11 | |
| 25-inch | | | 4 1/2 | 5 1/2 | 6 1/2 | 7 1/2 | 8 1/2 |

Example:—A 15-inch lens used at a distance of 25 feet from the screen will project an image 8 feet square.

Table 3: For Opaque Objects, 6 x 6-inch Opening

| Focus of Lens | Distance from Lantern to Screen | | | | | | |
|---------------|---------------------------------|--------|--------|--------|--------|--------|--------|
| | 15 ft. | 20 ft. | 25 ft. | 30 ft. | 35 ft. | 40 ft. | 45 ft. |
| 15-inch | 5 1/2 | 7 1/2 | 9 1/2 | 11 1/2 | | | |
| 18-inch | 4 1/2 | 6 | 8 | 9 1/2 | 11 | | |
| 25-inch | | 4 1/2 | 5 1/2 | 6 1/2 | 8 | 9 | 10 |

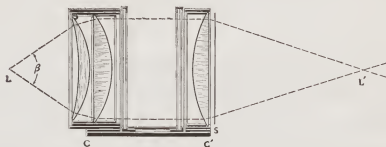
Table 4: For Opaque Objects, 8 x 8-inch Opening

| Focus of Lens | Distance from Lantern to Screen | | | | | |
|---------------|---------------------------------|--------|--------|--------|--------|--------|
| | 15 ft. | 20 ft. | 25 ft. | 30 ft. | 35 ft. | 40 ft. |
| 15-inch | 7 1/2 | 10 | 13 | | | |
| 18-inch | 6 | 8 | 10 1/2 | | | |
| 25-inch | | 5 1/2 | 7 | 9 | 10 1/2 | 12 |

Condensing Systems

The condensing lenses play an important part in the optical system of any projection apparatus, inasmuch as the uniformity of illumination and the size of the illuminated field are dependent on the purity of the glass they are made from (freedom from striae, bubbles, etc.) and on the correctness of their focal length.

We furnish two different condensing systems, a double system, consisting of two plano-convex lenses with the convex sides facing each other, and a triple system composed of a meniscus and a plano-convex lens mounted in close proximity and another plano-convex lens mounted separately, as shown in the illustration. Both systems provide for the insertion of a water cooling cell between the plano-convex lenses, if desired.



Sectional View of Triple Condensing System, Showing Light Rays Coming from Illuminant, L, Rendered Parallel by Rear Condensers, C, and Converged Again by Front Condenser, C', at L'.

The two rear lenses of the triple system render the light parallel. This system permits a **more universal application of the light**, since by simply removing the front lens a parallel beam is obtained for any other form of projection which may require it, without necessitating the substitution of a special system.

A difficulty encountered with all condensing systems is the liability of breakage, due to unequal expansion or contraction caused by sudden extreme changes in temperature. We have devised and patented a **ventilated mount**, which we believe to be the best safe-

Our Ventilated
Mount



Patent Ventilated Condenser Mount.

guard on the market against the breakage of lenses. The rear lens, which comes in closest proximity to the lamp, is one-half inch smaller in diameter than the front

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lens, or lenses, being set in an inner rim within the larger rim of the mount. The intervening space of one-quarter inch around the circumference is left open, except at the connecting points, permitting a nearly even circulation of air on both sides of the lens.

Either of these condensing systems will give satisfactory results with lantern slides. With most of our outfits we supply the triple system. Better optical corrections are possible with three elements than with two, enabling a sharper focusing of the light rays in the diaphragm plane of the projection lens. The second plano-convex lens is of the exact focal length to do this, i. e. same focus as that of the projection lens.

Screens

The brilliancy of the picture on the screen is largely dependent upon the percentage of light rays that are reflected back from the screen to the eye of the observer. The character of the screen, then, is an important element to consider.

The reflecting quality of a screen is determined by its opacity and surface finish. A well finished white wall serves the purpose admirably, but as such a wall is not often available a good, heavy cloth, such as shade cloth, properly treated and coated with either a white opaque or an aluminum finish, makes a very desirable screen. This screen should be mounted on a spring roller so that it may be rolled up, when not in use, and thus protected from dust and dirt.

The aluminum finished surface has about twice the reflecting value of the ordinary white surface, but a narrower field. Thus, while an aluminum screen is very advantageous, particularly in the projection of opaque objects, it should only be installed where the audience can be seated within a total angle of 60° from the center of the screen.

For portable screens, which can be readily folded up into a small space, white sateen is perhaps the most efficient, because of its highly finished surface.

Model B Balopticon

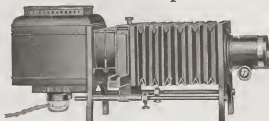


Figure 1—Model B with Mazda Lamp and $2\frac{5}{16}$ -Inch Diameter Lens.

This compact, efficient little instrument met with instant success when placed on the market and is now one of the most popular projection lanterns in its class. It meets the growing demand for a really **high grade stereopticon** at a moderate price and is designed for use with lantern slides only in class rooms, Sunday schools and the home. It is a great favorite with the amateur photographer. He can easily make slides for it from his negatives, or with attachments he can use it effectively as an enlarging lantern for negatives up to $3\frac{3}{4} \times 4\frac{1}{4}$ inches.

We equip this model with either the 250-watt, **gas-filled Mazda** lamp, or with the **small arc lamp** and $4\frac{1}{2}$ -ampere rheostat, where electricity is available. On account of its high efficiency and simplicity of operation, the former type of illuminant is usually preferred. It equals the illumination given by the 5-ampere arc lamp, yet consumes only $2\frac{1}{2}$ amperes of current and is entirely automatic.

Where electricity is not available, a double-jet acetylene burner is used with a special spherical mirror. The same style of lamp house is used with both the acetylene burner and the Mazda lamp (Figure 1).

Special features of this lantern are: the method of ventilating both lamp house and condenser mount, permitting the use of lantern slide films if desired without the expense and inconvenience of a water cell; the extreme compactness and light weight, which make it a very desirable equipment for traveling lecturers or salesmen who use lantern slides in demonstrating their lines.

Specifications

Base—Consists of front and rear metal standards carried on sliding rods.

Lamp House—Of sheet metal with special ventilation; two styles—one for arc lamp measuring $6\frac{1}{2} \times 2\frac{1}{2} \times 5$ in., and that for Mazda or acetylene lamp measuring $6\frac{1}{2} \times 7 \times 5$ in.; both styles fit in grooves to rear standard and can be instantly interchanged by lifting out one and sliding in the other.

Illuminant—Our 250-watt, gas-filled, Mazda stereopticon lamp, Adjustable Baby Arc Lamp with small $4\frac{1}{2}$ -ampere rheostat, or double-jet acetylene burner with mirror, as desired; carbons of arc lamp can be adjusted independently and then easily fed forward by turning a single convenient button.

Condensing System—Our regular double system, $4\frac{1}{2}$ -in. diameter, in special ventilated mount from which lenses can be easily removed for cleaning.

***Slide Carrier**—Our double carrier, No. 4430, with elevating device.

Bellows—Mounted on metal frames which slide in metal ways.

*The quick changing slide carrier, No. 4449, giving a dissolving effect, may be substituted for \$1.50 extra. We can supply to order carriers for **small** slides, so that one may use either the standard slide or the special small size now being offered.

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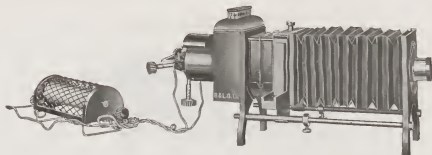


Figure 2—Model B with Baby Arc Lamp and 4½-Ampere Rheostat.

Projection Lens—Special achromatic lens of 10-in. focus in spiral focusing mount regularly supplied; either 8-in. or 12-in. focus lens can be furnished without extra charge.

Dimensions—Length (ready for operation), 20 in. over all with arc, or 22 in. with other lamps; height 9¾ in.

Weight—Complete in case, 13-15 lbs., depending on equipment.

Case—Sheet metal, 7¼ x 9½ x 15 in., lacquered in black; with carrying strap.

With Mazda Lamp

| Code Word | Cat. No. | Specifications | Price |
|---------------------|----------------|---|----------------|
| <i>Dermopteran</i> | BM 8 s | Model B Balopticon with 250-watt, 115-volt Mazda lamp with reflector, 15 feet of cord and plug; special 8-in. focus lens in spiral focusing mount . . . | \$22.00 |
| <i>Destrer</i> | BM 10 s | Same as above, but with 10-in. focus lens . . . | 22.00 |
| <i>Dermopteri</i> | BM 12 s | Same as above, but with 12-in. focus lens . . . | 22.00 |
| <i>Deserite</i> | BM 10 | Same as above, but with a regular quality, 2½-in. diam., 10-in. focus lens in rack and pinion mount in place of special lens . . . | 30.00 |
| <i>Dermoblast</i> | BM 12 | Same as above, but with 12-in. focus lens . . . | 30.00 |
| <i>Dermogastric</i> | BM 15 | Same as above, but with 15-in. focus lens . . . | 30.00 |

NOTE—While the Model B is here listed with the 250-watt Mazda, a 400-watt Mazda lamp will be supplied for \$2.00 extra.

For Mazda lamps on higher voltages we supply resistances (see "Accessories").

With Arc Lamp

| Code Word | Cat. No. | Specifications | Price |
|--------------------|----------------|---|----------------|
| <i>Dermophyte</i> | BA 8 s | Model B Balopticon with arc lamp, 4½-ampere, 110 volt rheostat, 15 feet of cord, switch and plug; special 8-in. focus lens in spiral focusing mount . . . | \$24.00 |
| <i>Destroy</i> | BA 10 s | Same as above, but with 10-in. focus lens . . . | 24.00 |
| <i>Dermoplasty</i> | BA 12 s | Same as above, but with 12-in. focus lens . . . | 24.00 |

With Acetylene Burner

| Code Word | Cat. No. | Specifications | Price |
|--------------------|----------------|---|----------------|
| <i>Dermography</i> | BG 8 s | Model B Balopticon with double-jet acetylene burner and special glass reflector; special 8-in. focus lens, in spiral focusing mount . . . | \$20.00 |
| <i>Dorp</i> | BG 10 s | Same as above, but with 10-in. focus lens . . . | 20.00 |
| <i>Dermoidal</i> | BG 12 s | Same as above, but with 12-in. focus lens . . . | 20.00 |
| <i>Derne</i> | BG 10 | Same as above, but with regular quality, 2½-in. diam., 10-in. focus lens in rack and pinion focusing mount . . . | 28.00 |
| <i>Derndul</i> | BG 12 | Same as BG 10, but with 12-in. focus lens . . . | 28.00 |
| <i>Derthead</i> | BG 15 | Same as BG 10, but with 15-in. focus lens . . . | 28.00 |

Special Traveling Outfits

The use of the stereopticon is constantly increasing among institute workers, county agriculturalists and others who travel about delivering lectures—in which class may be included salesmen of machinery and similar non-portable articles, as well as promoters of educational campaigns in the industrial field.



Figure 3—Special Portable Model B Balopticon
BMP in Case.

The Model B Balopticon naturally appeals for such use because of its compactness, light weight and simplicity of operation. We have designed a special carrying case of wood covered with black leatheret and provided with metal corners and locks (Figure 3). Space is provided for the Model B with Mazda lamp also compartments for an extra Mazda bulb and for an acetylene burner, the holder of which will interchange with that on the Mazda lamp. As a source of supply for the acetylene burner we recommend the acetylene gas tanks,

as used on automobiles. If one does not wish to carry the tanks about, they can be rented in almost any locality where a lantern would be used.

The Model B with the two forms of illuminant in the special carrying case has proved very popular. The outfit in its case weighs 20 pounds, and the latter measures $22\frac{1}{4} \times 20\frac{1}{2} \times 7\frac{3}{4}$ inches

| Code Word | Cat. No. | Specifications | Price |
|-------------------|----------------|--|----------------|
| <i>Despuile</i> | BMP 10 | Model B Balopticon with 250-watt, 115-volt, Mazda lamp, $2\frac{5}{16}$ -in. diameter, 10-in. focus lens in rack and pinion mount; in special carrying case of wood covered with black leatheret, with metal corners and locks | \$37.50 |
| <i>Despume</i> | BGP 10 | Same as above but with double-jet acetylene burner in place of Mazda lamp and with special glass reflector fitted in lamp house | 35.50 |
| <i>Desputeson</i> | BMGP 10 | Model B Balopticon with 250-watt, 115-volt Mazda lamp and with acetylene burner to interchange with Mazda lamp; with lens and carrying case as described above | 42.00 |

NOTE—We are listing with this outfit the 10-inch focus lens, which is the one generally required. The 12 or 15-inch focus lens can be supplied at the same price. If one of these is preferred, substitute "12 or 15" for the numeral "10" in the above catalog numbers.

We recommend that an extra Mazda lamp be included in traveling outfits to guard against possible breakage or burning out. The 250-watt Mazda with clear globe is \$3.00 net.

Model B Equipment for Enlarging and Lantern Slide Making

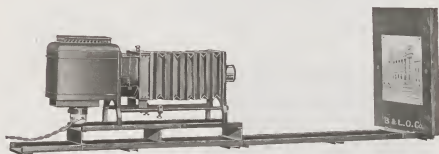


Figure 4—Model B Outfit Set up for Enlarging (with Mazda Lamp).

We have devised a set of accessories by means of which the Model B Balopticon can be readily converted into an efficient **enlarging lantern**, or a camera for making slides, as desired. Since the Balopticon is always readily available for projection work, one obtains three complete outfits in one apparatus by adding these accessories to his regular Model B. Amateur photographers can thus make enlargements of their negatives, they can make lantern slides as well and project the slides—all with one apparatus. Negatives up to 4 x 5 inches may be used, although the area that can be covered is limited to approximately 4 inches in diameter.

For enlarging the outfit is set up as illustrated above. The sensitized paper is attached to the easel and the Balopticon moved on the tracks to the proper distance for making an enlargement of the desired size, the negative being placed in the special holder which is substituted for the lantern slide holder on the Balopticon. Lantern slides can be made from negatives up to 5 x 7 inches in size. The lamp house of the Balopticon is attached to the back of the easel board, the central portion of which is removed to take the negative frame, the special frame carrying the plate holder taking the place of the regular slide holder, while the former with bellows and lens is set up the same as for enlarging.

A special circular describing more fully these accessories and their use will be sent upon request.

| Code Word | Cat. No. | Specifications | Price |
|------------------|-------------|---|----------------|
| <i>Delignate</i> | 5338 | Set of Accessories for making enlargements and lantern slides with the Model B Balopticon complete | \$18.00 |
| <i>Dab</i> | 4006 | Balo Projection Lens of highest grade; 6-in. focus, 1½-in. diam. in rack and pinion focusing mount; (for making enlargements at shorter working distances) | 10.50 |
| <i>Dapedium</i> | 5335 | Flange for adapting photographic lens to Balopticon, permitting it to be substituted for regular projection lens. (Be sure to specify what lens is to be adapted, when ordering) | 2.00 |

Model BB Dissolving Balopticon



It is an accepted fact that the most pleasing way of projecting lantern slides is with a dissolving view lantern, by means of which the "racing" of the slide across the screen or a short interval of darkness between slides is entirely eliminated. This not only relieves eyestrain, but the dissolving of one view into the succeeding one produces a very pleasing effect.

A number of devices have been produced for use on a single lantern for which claims of producing dissolving views have been made, but they either show movement of the slide upon the screen or produce momentary darkness. True dissolving effects can only be produced by the use of two lanterns fitted with a device by means of which the pictures are projected alternately by one lantern and then the other.

Believing that this feature in a projecting lantern makes a strong appeal, we have designed the **Model BB Balopticon**, which is very compact and extremely simple to operate. This is truly **two lanterns in one**, as there are two light sources and two complete optical systems side by side in the one lantern body. This construction makes possible the **maximum compactness** and eliminates the setting up and adjusting of the average double dissolving lantern. No more adjustments are required than in the ordinary lantern, except the adjustment of the lenses by means of sliding plates on the front standard, so that the pictures are superimposed on the screen. By means of the construction employed the complete equipment can be put in one carrying case—a decided advantage to travelling lecturers or to those who cannot leave their apparatus permanently installed.

The dissolving effect, or the change from one picture to the next, is accomplished by a switch which gradually cuts off the current to one lamp and turns it on in the other at a corresponding rate so that the screen is never dark. While the effect is not quite as gradual and completely dissolving as when using one of our patented Iris diaphragm dissolvers, the device will be found extremely satisfactory and considerably less expensive.

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Two 400-watt Mazda lamps are used, but due to the particular way in which they are connected up, there are never more than 400 watts drawn at one time, so that the apparatus requires only one lead of wire and can be connected to any regular lighting socket. In addition to this advantage the cutting off of the lamp when not required increases the length of service and materially reduces the heat.

Specifications

Base—Consists of front standard supporting projecting lenses, and sliding rods connecting with lamp house.

Lamp House—Of sheet metal, specially ventilated, with removable top for access to lamps; measures 7 x 9 $\frac{5}{8}$ x 10 $\frac{1}{4}$ in.

Illuminant—Two 400-watt gas-filled Mazda lamps with glass reflectors; connected with dissolving switch.

Condensing System—Two regular double systems, 4 $\frac{1}{2}$ in. diameter, in special ventilated mount from which lenses can be easily removed for cleaning.

Slide Carrier—Permanently fastened in front of condensing system, with grooves for either American or English size of slide.

Bellows—Mounted on metal frames which slide in metal ways.

Projection Lens—Two of our regular Balo lenses, either 1 $\frac{5}{8}$ in. diameter or 2 $\frac{5}{16}$ in. diameter, as desired.

Dimensions—Length (ready for projection with 15-in. focus lenses) over all, 26 $\frac{1}{2}$ in.

Weight—Complete in case with 2 $\frac{5}{16}$ in. diameter lenses, 30 lbs.

Case—Sheet metal, 15 $\frac{1}{2}$ x 10 $\frac{1}{2}$ x 10 $\frac{1}{2}$ in., lacquered in black; with hinged side door, two catches and carrying strap.

| Code Word | Cat. No. | Specifications | Price |
|-------------------|----------------|---|----------------|
| <i>Default</i> | BBM 8q | Model BB Dissolving Balopticon with two 400-watt, 110-volt gas-filled Mazda lamps with glass reflectors, dissolving switch, pass-through, cut-out switch, and 15 feet of extension cord; two 1 $\frac{5}{8}$ -in. diam., 8-in. focus projection lenses and carrying case | \$55.00 |
| <i>Defaulter</i> | BBM 10q | Same as above but with 10-in. focus projection lenses | 55.00 |
| <i>Defeasance</i> | BBM 10 | Same as above but with 2 $\frac{5}{16}$ -in. diam. 10-in. focus projection lenses | 65.00 |
| <i>Defeasible</i> | BBM 12 | Same as above but with 12-in. focus projection lenses | 65.00 |
| <i>Defeat</i> | BBM 15 | Same as above but with 15-in. focus projection lenses | 65.00 |

Model C Balopticon

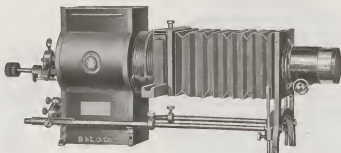


Figure 1—Model C Balopticon with Arc Lamp.

The **Model C Balopticon**, on account of its high degree of efficiency, adaptability to varying requirements and ease of manipulation, has proved itself to be a most satisfactory lantern for general use in the graded school, high school and university where an inexpensive but thoroughly high grade lantern for lantern slide projection is desired. It is, of course, equally desirable for general illustrative work in the church, Y. M. C. A. or lodge. Another feature of the Model C is that it accommodates attachments for the projection of opaque objects and for projecting transparent objects held in a horizontal plane, as well as the simple microscope attachment.

The body of the lantern is made of heavy sheet metal, the different parts being stamped out by special forming tools. This provides for an instrument of **light weight**, but at the same time one of the **required rigidity**.

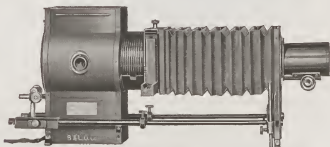


Figure 2—Model C Balopticon with Gas-Filled Mazda Lamp.

Two styles of lamp houses are offered: the **small lamp house**, Figures 1 and 2, and the **large light-tight**, or Underwriter's Model, lamp house, Figure 3. The latter meets the requirements in every way of the Boards of Underwriters and is especially recommended where more than 15 amperes of current are to be used or where an opaque attachment is to be operated, as this style of lamp house entirely shuts off all the rays of light which would otherwise affect the brilliancy of the picture on the screen.

We list this instrument with four different illuminants: the arc lamp, gas-filled Mazda lamp, acetylene burner and oxyhydrogen burner, all of which are provided with the same type of base so that they are readily interchangeable in the lamp house.

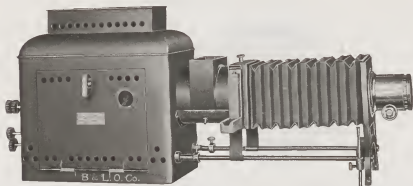


Figure 3—Model C Balopticon with Large Lamp House and Water Cell.

Where electricity is available and an outlet is provided with a carrying capacity of 15 or more amperes, we recommend the **arc lamp and a rheostat** of 15 amperes or more capacity. Should no other outlet than the ordinary lighting socket be available, the carbon holders of the arc lamp can be fitted with bushings and the small pencil carbons used in connection with one of our $4\frac{1}{2}$ -ampere rheostats. This feature makes it possible to use the lantern under different wiring conditions by having a combination 5, 10 and 15-ampere rheostat.

The arc lamp supplied is a 90° hand-feed arc lamp with horizontal and vertical carbons and with feeding gears controlling the carbons independently or together.

A very desirable form of illuminant, and one that is rapidly taking the place of the arc lamp for general class room use, is the new **400-watt, gas-filled Mazda lamp** with its reflector. It is entirely automatic and noiseless in operation, can be attached to any convenient lamp socket and gives illumination considerably exceeding that of a 5-ampere arc lamp. For large lecture rooms, or auditoriums where the lantern is placed 50 feet or more from the screen and a fairly large picture is to be projected, we recommend the **1000-watt, gas-filled Mazda lamp**, which draws about 9 amperes but gives illumination fully equal to the 15 or 20-ampere arc lamp. The size of this lamp necessitates the use of the large, light-tight lamp-house, as shown in Figure 3.

In cases where electricity is not available, either the **acetylene or oxyhydrogen burner** is a very satisfactory substitute. The acetylene burner which we supply consists of two jets with a special, spherical glass reflector. The consumption of gas per hour is $1\frac{1}{2}$ cubic feet. The illumination from this burner equals that from a four-jet burner and is entirely free from flare streaks or flicker. The most convenient and satisfactory source of gas supply is the acetylene tank, as used on motorcycles and automobiles.

The oxyhydrogen burner gives illumination exceeding in brilliancy that of the acetylene burner, but is not so convenient and costs somewhat more to operate. An oxyhydrogen generator is recommended as a source of supply.

The **projection lenses** supplied on the Model C Balopticon are of the **new Balo series**, the highest grade lenses made for lantern slide projection. They are furnished in two diameters: $1\frac{5}{8}$ and $2\frac{5}{16}$ inches. The former is quite satisfactory when used with the arc lamp, since the light source is small compared to that of the Mazda lamp or acetylene burner. The $2\frac{5}{16}$ -inch diameter lens should be used for all focal lengths over 10 inches and by all means with such illuminants as the Mazda lamp and acetylene burner. In the latter cases the larger size lens gives an increase of about 40 per cent. in illumination.

Double Dissolving Outfits

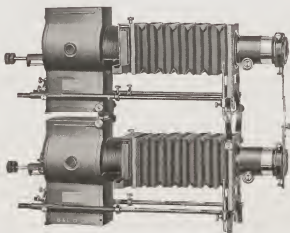


Figure 4—Double Dissolving Model C Balopticon.

To avoid the eyestrain and disagreeable effect produced by the alternate darkening and lighting of the screen, together with the "racing" of the slides across the screen in changing, so-called dissolving outfits are employed, by means of which each view is made to fade gradually and blend into the succeeding picture.

This effect is very satisfactorily accomplished by combining two Model C Balopticons and fitting the lenses with our patent **iris diaphragm dissolver**. By means of simple connections the lanterns are mounted one above the other, so that the two fields are coincident upon the screen. The iris diaphragm dissolver consists of an iris diaphragm fitted to each lens, the two being jointly operated by a connecting rod which opens one diaphragm as the light is shut off by the other.

The two Balopticons can be quickly put together or dismantled, so that the lanterns can be used separately in class rooms and combined for use in the auditorium.

Specifications

Base—Consists of metal feet on bottom of lamp house and front metal standard of one piece with front board, the whole carried on sliding rods; front standard provided with elevating device for tilting instrument as desired.

Lamp House—Two styles, **small** and **large**, both of sheet metal, fitted with our special, patent, light-tight ventilator and provided with two observation windows; small style measures $6\frac{1}{4}$ in. long, 11 in. high and 6 in. wide, asbestos lined; large style measures $13\frac{1}{4}$ in. long, 14 in. high and $7\frac{1}{2}$ in. wide, light-tight, constructed of double walls with air space between and provided with large light-tight door on the side—**conforms to most rigorous requirements of Boards of Underwriters.**

Illuminant—Hand-feed arc lamp for direct or alternating current with adapters for small carbons, gas-filled Mazda lamp, acetylene or oxhydrogen burner.

Condensing System—Our regular double system in patent, ventilated mount; diameter, $4\frac{1}{2}$ in.

***Slide Carrier**—Our double carrier, No. 4430, with elevating device.

Bellows—Mounted on metal frames which slide in metal ways, with extension sufficient for 18-inch focus lens.

Projection Lens—Our **Balo** lens with rack and pinion adjustment.

Dimensions—Length, extended, 27 in. without lens; height, 11 or 14 in.

Weight—Alone, with small lamp house, 14 lbs.; in case, 24 lbs.

Case—Regularly furnished only with small lamp house (see foot note under price list); of metal, neatly lacquered in black, measuring $22\frac{3}{4}$ x 12 x 7 in. and provided with carrying strap.

*The quick-changing slide carrier, No. 4449, giving a dissolving effect, may be substituted for **\$1.50** extra. We can supply to order carriers for **small** slides, so that one may use either the standard slide or the special small size now being offered.

With Arc Lamp

| Code Word | Cat. No. | Specifications | Price |
|-----------------|----------------|--|----------------|
| <i>Due</i> | CA 8q | Model C Balopticon with small lamp house and $1\frac{1}{2}$ -in. diam., 8-in. focus, projection lens . . . | \$30.00 |
| <i>Duane</i> | CAL 8q | Same as above, but with large lamp house . . . | 37.50 |
| <i>Duenna</i> | CA 10q | Model C Balopticon with small lamp house and $1\frac{1}{2}$ -in. diam., 10-in. focus, projection lens . . . | 30.00 |
| <i>Dumpling</i> | CAL 10q | Same as above, but with large lamp house . . . | 37.50 |
| <i>Dureis</i> | CA 10 | Model C Balopticon with small lamp house and $2\frac{3}{16}$ -in. diam., 10-in. focus, projection lens . . . | 35.00 |
| <i>Duotone</i> | CAL 10 | Same as above, but with large lamp house . . . | 42.50 |
| <i>Duet</i> | CA 12 | Model C Balopticon with small lamp house and $2\frac{3}{16}$ -in. diam., 12-in. focus, projection lens . . . | 35.00 |
| <i>Duotype</i> | CAL 12 | Same as above, but with large lamp house . . . | 42.50 |
| <i>Dudgeon</i> | CA 15 | Model C Balopticon with small lamp house and $2\frac{3}{16}$ -in. diam., 15-in. focus, projection lens . . . | 35.00 |
| <i>Durmast</i> | CAL 15 | Same as above, but with large lamp house . . . | 42.50 |
| <i>Dubbeb</i> | CA 18 | Model C Balopticon with small lamp house and $2\frac{3}{16}$ -in. diam., 18-in. focus, projection lens . . . | 35.00 |
| <i>Dubber</i> | CAL 18 | Same as above, but with large lamp house . . . | 42.50 |

A carrying case is not regularly supplied with the large lamp house. For those outfits we can supply one of lacquered metal for **\$2.50** additional.

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With Mazda Lamp

| Code Word | Cat. No. | Specifications | Price |
|-----------------|---------------|--|----------------|
| <i>Duram</i> | CM 10 | Model C Balopticon with small lamp house, with 400-watt, 115-volt Mazda lamp with reflector and 2 $\frac{5}{16}$ -in. diam., 10-in. focus projection lens . . . | \$37.00 |
| <i>Durvan</i> | CM 12 | Same as above, but with 12-in. focus lens . . . | 37.00 |
| <i>Durvaun</i> | CM 15 | Same as above, but with 15-in. focus lens . . . | 37.00 |
| <i>Durze</i> | CM 18 | Same as above, but with 18-in. focus lens . . . | 37.00 |
| <i>Durack</i> | CML 10 | Model C Balopticon with large lamp house, 1000-watt, 115-volt Mazda lamp with glass reflector and 2 $\frac{5}{16}$ -in. diam., 10-in focus projection lens . . . | 52.50 |
| <i>Duse</i> | CML 12 | Same as above, but with 12-in. focus lens . . . | 52.50 |
| <i>Duselic</i> | CML 15 | Same as above, but with 15-in. focus lens . . . | 52.50 |
| <i>Dusiship</i> | CML 18 | Same as above, but with 18-in. focus lens . . . | 52.50 |

NOTE—Any of the above outfits listed with the 400-watt Mazda lamp can be fitted with a 250-watt lamp if desired at a reduction in price of \$2.00, and any of the outfits listed with the 1000 watt lamp can be fitted with the 500-watt lamp at a reduction in price of \$5.00. If such substitution is to be made, specify definitely on order.

For Mazda lamps on higher voltages we supply resistances (see "Accessories").

With Acetylene Burner

| Code Word | Cat. No. | Specifications | Price |
|-----------------|--------------|--|----------------|
| <i>Duckhood</i> | CG 10 | Model C Balopticon with small lamp house, double-jet acetylene burner with special glass reflector and 2 $\frac{5}{16}$ -in. diam., 10-in. focus projection lens . . . | \$33.00 |
| <i>Duckmeat</i> | CG 12 | Same as above, but with 12-in. focus lens . . . | 33.00 |
| <i>Duckey</i> | CG 15 | Same as above, but with 15-in. focus lens . . . | 33.00 |

With Oxyhydrogen Burner

| Code Word | Cat. No. | Specifications | Price |
|---------------|--------------|---|----------------|
| <i>Ducky</i> | CO 10 | Model C Balopticon with small house, oxyhydrogen burner and 2 $\frac{5}{16}$ -in. diam., 10-in. focus projection lens . . . | \$35.00 |
| <i>Duddie</i> | CO 12 | Same as above but with 12-in. focus lens . . . | 35.00 |
| <i>Duddle</i> | CO 15 | Same as above but with 15-in. focus lens . . . | 35.00 |

NOTE—Any of the above outfits can be fitted with a Water Cell for \$5.00 extra.

Double Dissolving Equipments

A double dissolving equipment can be made up by combining two of any of the above models and adding the iris dissolver. The price is twice that of the single equipment, plus the price of the dissolver. In ordering use the catalog number or code word of the outfit desired, preceded by the word "Double".

| Code Word | Cat. No. | Specifications | Price |
|--------------|-------------|--------------------------|----------------|
| <i>Deign</i> | 4490 | Iris Dissolver | \$15.00 |

Attachments

While the Model C Balopticon is primarily a lantern for slide projection, it can nevertheless be fitted with attachments for the projection of opaque objects, microscopical specimens or large transparent objects held in a horizontal plane.

Attachment for Opaque Objects

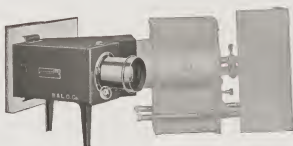


Figure 5—Model C Attachment for Opaque Objects.

The attachment for the projection of opaque objects, such as photographs, illustrations from text books, post cards, etc., Figure 5, can be very easily attached to the lamp house portion of the Model C Balopticon by means of the sliding ways on the front of the slide carrier support which regularly carries the rear end of the bellows. The front standard and rods are easily removed. If the apparatus is to be used at a comparatively short distance from the screen, the 12-inch focus lens of $2\frac{5}{16}$ -inch diameter can be satisfactorily used, but for distances of 20 feet or more from the screen we recommend the use of the 4-inch diameter, 15 or 18-inch focus lens, since the illumination is increased according to the square of the diameter of the lens. The use of the attachment is recommended only when the apparatus can be placed at a comparatively short distance from the screen (25 feet) in a well darkened room and with an arc lamp operating on at least 25 amperes of current.

| Code Word | Cat. No. | Specifications | Price |
|---------------|-------------|--|----------------|
| <i>Dusk</i> | 5080 | Model C Attachment for Opaque Objects, with $2\frac{5}{16}$ -in. diam., 12-in. focus lens and reversing mirror | \$35.00 |
| <i>Dumose</i> | 5082 | No. 5080, but with 4-in. diam., 15-in. focus lens | 67.00 |
| <i>Durham</i> | 5084 | No. 5080, but with 4-in. diam., 18-in. focus lens | 67.00 |

Vertical Attachments

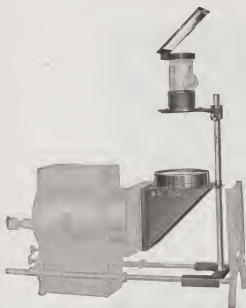


Figure 6—Vertical Attachment for Model C Balopticon.

An attachment that will be found of considerable value is the **vertical attachment** for the **projection of transparent objects held in a horizontal position**, Figure 6. This attachment consists of a prism-shaped metal box with mirror which is attached to the front of the slide carrier support. On the top of the box is a condenser which serves as a stage upon which to place the objects to be projected. The lens used for lantern slide projection can be attached to the arm supported by the vertical rod, and a mirror attached to the hood of the lens directs the beam of light to the screen. This attachment will be found of particular service in demonstrating various phenomena in chemistry and

physics, such as crystallization, lines of magnetic force, etc.

| Code Word | Cat No | Specifications | Price |
|----------------|-------------|--|----------------|
| <i>Drumlin</i> | 4376 | Vertical Attachment for Model C Balopticon , consisting of mirror box, $4\frac{15}{32}$ -in. diam. condenser in mounting vertical rod with lens support and mirror for $1\frac{3}{8}$ -in. diam. lens | \$10.00 |

Microscope Attachment

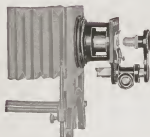


Figure 7—Simple Microscope Attachment.

Teachers of biology will find much use for the **simple microscope attachment**, Figure 7, by means of which prepared slides of plant sections, parts of insects, etc., may be projected upon the screen. This attachment fits on the front standard in the same flange carrying the projection lens. Any regular microscope objective of a power not higher than 16 mm can be used on this attachment with satisfactory results.

| Code Word | Cat. No. | Specifications | Price |
|---------------|-------------|--|----------------|
| <i>Durify</i> | 4375 | Simple Microscope with rack and pinion adjustment and substage condenser, but without objective | \$15.00 |

Special Portable Model C Outfits



Figure 8—Special Portable Model C Balopticon CGT Mounted on Tripod.

On account of its light weight and compactness and the ready interchangeability of the different illuminants as required, the Model C is a favorite among institute and agricultural workers and traveling lecturers in general. As an aid to the convenient transportation of a complete outfit, we offer two styles of specially constructed carrying cases containing the complete equipment.

The case shown in Figure 8 is of wood covered with leatheret and measures $29\frac{1}{2} \times 13\frac{1}{2} \times 8\frac{3}{4}$ inches. The cover is detachable and carries a metal plate to which the head of a camera tripod may be attached. This cover on a solid tripod forms a very convenient and substantial support for the lantern during operation. Space is provided in the case for a second type of illuminant and for a 10 cu. ft. acetylene gas tank, as well as for the tripod. The weight with two illuminants, tripod and tank is 40 pounds.

The most compact outfit possible is illustrated in Figure 9. The case is of wood covered with leatheret and has hinged cover and metal corners. Space is provided for an extra illuminant, but not for tank or tripod. The case measures $23\frac{3}{4} \times 12 \times 7\frac{1}{2}$ inches, and the complete outfit weighs only 22 pounds.

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Figure 9—Special Portable Model C Balopticon CGP in Case.

| Code Word | Cat. No. | Specifications | Price |
|-------------------|---------------|--|----------------|
| <i>Durtye</i> | CGT 10 | Model C Balopticon with $2\frac{3}{16}$ -in. diam., 10-in. focus projection lens and acetylene burner fitted in special traveling case with detachable top to be used in connection with tripod for lantern support; tripod included; space provided for extra illuminant and acetylene gas tank, but not including tank . . . | \$45.00 |
| <i>Duroy</i> | CMT 10 | Same as above, but with 400-watt, 115-volt Mazda lamp in place of acetylene burner . . . | 49.00 |
| <i>Durdenite</i> | CGMT10 | Same as above, but with both acetylene burner and 400-watt, 115-volt Mazda lamp . . . | 55.75 |
| <i>Durangite</i> | CGP 10 | Model C Balopticon with $2\frac{3}{16}$ -in. diam., 10-in. focus projection lens and acetylene burner in special portable case (see Figure 9) with space for extra illuminant . . . | 40.50 |
| <i>Durawatral</i> | CMP 10 | Same as above, but with 400-watt, 115-volt Mazda lamp in place of acetylene burner . . . | 44.50 |
| <i>Durabl</i> | CGMP10 | Same as above, but with both acetylene burner and 400-watt, 115-volt Mazda lamp . . . | 51.25 |

NOTE—We recommend that an extra Mazda lamp be included in traveling outfits equipped with this form of illuminant to guard against breakage or burning out. Space for this extra bulb is provided in both types of carrying case. The 400-watt Mazda lamp with clear globe is \$5.00 net (see "Accessories").

The above outfits are listed with the 10-inch focus lens, which is the one generally required. The 12 or 15-inch focus lens can be supplied at the same price. If one of these is preferred, substitute "12" or "15" for the numeral "10" in the above catalog numbers.

Double Dissolving Model C Balopticon with Moving Picture Attachment

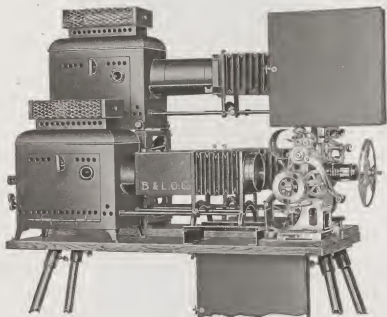


Figure 10 — Double Dissolving Model C Balopticon with Power's No. 6a Mechanism

This is an ideal outfit for Y. M. C. A., church, school or college auditoriums, affording unusually attractive possibilities for entertainment and educational purposes. It permits one to combine regular **dissolving views** in lecture work with **moving pictures** in a very pleasing manner, since it provides for instant interchange between the two.

Unlike other equipments of this character now on the market, there is no shifting of the lower lamp house when one wishes to change from lantern slides to moving pictures, or vice versa. The two Balopticons are securely mounted on a substantial baseboard in the manner illustrated above. The lamp house of the lower Balopticon is mounted in connection with the moving picture mechanism. The lantern slide section of this Balopticon is placed under that of the upper lantern and alongside the moving picture attachment. The dark chamber in front of the lamp house on the lower Balopticon contains a movable mirror which directs the light into the lantern slide section when projecting dissolving views.

The upper Balopticon, of course, is used only for lantern slide projection. The projection lenses of this lantern and of the lower lantern slide section are equipped with our iris diaphragm dissolver, which automatically closes the diaphragm of the upper lens as the light is admitted to the lower, and vice versa. The

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mirror, which directs the light into the lantern slide section of the lower Balopticon, is controlled by the exterior lever, shown on top of the dark chamber (Figure 10). In order to change from one kind of projection to the other it is only necessary to shift this mirror, thus directing the beam of light either through the moving picture projection lens or over into the lantern slide section of the lower Balopticon, as desired.

Another feature of these outfits lies in the fact that **separate condensing systems** are supplied for lantern slides and for moving pictures, suitable for their respective projection lenses. Because of this feature maximum efficiency is attained in both kinds of work.

Any of the standard moving picture mechanisms (Edison, Powers or Simplex) are supplied with this outfit. All are fitted with the regular Bausch & Lomb projection lenses, which are of the highest quality. Both Balopticons are equipped with light-tight lamp houses with special ventilating device. We provide four strong legs, adjustable for height, which attach to the corners of the baseboard, giving a substantial stand to be raised, lowered or tilted as desired.

| Code Word | Cat. No. | Specifications | Price |
|----------------|-------------|---|-----------------|
| <i>Durenol</i> | 5210 | Double Dissolving Model C Balopticon , complete with light-tight, specially ventilated lamp houses and 10, 12 or 15-inch focus, $2\frac{1}{16}$ -in. diam. projection lenses, mounted on stand (Be sure to specify focus of projection lenses desired) | \$175.00 |
| <i>Durn</i> | 5212 | No. 5210 with Edison Type D Moving Picture Mechanism complete with magazine for 12-in. reels and with take-up device, automatic fire shutter and lens | 347.00 |
| <i>Duroc</i> | 5214 | No. 5210 with Power's No. 6a Mechanism complete with 12-in. upper and lower film magazines with take-up device, automatic fire shutter and lens | 363.00 |
| <i>Duyong</i> | 5216 | No. 5210 with Simplex Moving Picture Mechanism complete with 16-in. upper and lower film magazines, take-up device and 14-in. reels, automatic fire shutter and lens, and film rewinder | 413.00 |

We recommend with any of these outfits one of our **adjustable rheostats** for 15 to 25 amperes and one from 15 to 35 amperes, to be selected according to voltage available.

Model D Balopticon

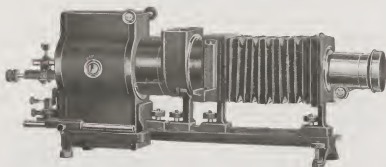


Figure 1—Model D Balopticon with Small Lamp House.

The **Model D Balopticon** is constructed on what is known as the **optical bed** type of construction. An accurately milled bed of lathe type is supported by feet at either end, those at the front being provided with leveling screws. To this optical bed the lamp house containing the arc and the standards supporting the different accessories are attached by means of clamping blocks. These standards may be adjusted along the bed to any position, and the act of clamping fixes them **rigidly in optical alignment**. Science teachers have been quick to appreciate the refinements and conveniences of this Balopticon, and its optical bed affords convenient accommodation for the many accessories used in science laboratories.

The Model D is equipped with the triple condensing system and a water cooling cell, which makes it the most perfect outfit for lantern slide projection. A combination of two of these instruments, equipped with our iris dissolver, makes an excellent **double dissolving** outfit for auditorium use (see Figure 2). The lanterns are readily separated for use in class rooms and laboratories.

Two styles of lamp house are offered. The **large, light-tight housing** meets the most rigid requirements of the Boards of Underwriters. It is particularly recommended where a part of the audience is seated back of the lantern and for use with arcs of high amperage. This lamp house is well adapted to double dissolving outfits. The small lamp house is illustrated in Figure 1.

Specifications

Base—Consists of cast iron supports of 6-in. spread, front and back, supporting optical bed $2\frac{3}{4}$ in. in height; front support provided with elevating screws.

Optical Bed—Of lathe type, carefully planed, accommodating supports for different parts which may be adjusted as desired and rigidly clamped; measures $19\frac{1}{2}$ in. in length and accommodates projection lenses up to 15-in. focus; two models (see DA 18 and DAL 18 below) are furnished with 25-in. optical bed accommodating projection lenses up to 22-in. focus.

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Lamp House—Two styles, **small** and **large**, both of sheet metal, fitted with our special, patent, light-tight ventilator and provided with two observation windows; small style measures $6\frac{1}{4}$ in. long, 11 in. high and 6 in. wide, asbestos lined; large style measures $13\frac{1}{2}$ in. long, 15 in. high and $7\frac{1}{2}$ in. wide, light-tight, constructed of double walls with air space between and provided with large light-tight door on the side—**conforms to the most rigorous requirements of Boards of Underwriters.**

Illuminant—Hand-feed arc lamp for direct or alternating current.

Condensing System—Our triple system in patent, ventilated mount; provided with water cooling cell; diameter, $4\frac{1}{2}$ in.

***Slide Carrier**—Our double carrier, No. 4430, with elevating device.

Bellows—Mounted on metal frames which slide in metal ways.

Projection Lens—Our Balo lens with rack and pinion adjustment.

Dimensions—Length, extended, 32 in. without lens; height, $11\frac{3}{4}$ in. or 15 in.

Case—Regularly furnished only with small lamp house (see foot note under price list); strongly built of wood, measuring $33 \times 13\frac{1}{4} \times 8\frac{1}{2}$ in. and provided with iron handle; fitted with strong spring catches and locks.

*The quick-changing slide carrier, No. 4449, giving a dissolving effect, may be substituted for **\$1.50** extra.

| Code Word | Cat. No. | Specifications | Price |
|------------------|----------------|--|----------------|
| <i>Daggle</i> | DA 10q | Model D Balopticon as described with small lamp house and $1\frac{3}{8}$ -in. diam., 10-in. focus projection lens | \$65.00 |
| <i>Darling</i> | DAL 10q | Same as above, but with large lamp house . . . | 72.50 |
| <i>Deck</i> | DA 10 | Model D Balopticon with small lamp house, $2\frac{5}{16}$ -in. diam., 10-in. focus projection lens . . . | 70.00 |
| <i>Dart</i> | DAL 10 | Same as above, but with large lamp house . . . | 77.50 |
| <i>Deal</i> | DA 12 | Model D Balopticon with small lamp house and $2\frac{5}{16}$ -in. diam., 12-in. focus projection lens . . . | 70.00 |
| <i>Dask</i> | DAL 12 | Same as above, but with large lamp house . . . | 77.50 |
| <i>Dealer</i> | DA 15 | Model D Balopticon with small lamp house and $2\frac{5}{16}$ -in. diam., 15-in. focus projection lens . . . | 70.00 |
| <i>Dantes</i> | DAL 15 | Same as above, but with large lamp house . . . | 77.50 |
| <i>Damnous</i> | DA 18* | Model D Balopticon with small lamp house, 25-in. optical bed and $2\frac{5}{16}$ -in. diam., 18-in. focus projection lens . . . | 73.50 |
| <i>Damourite</i> | DAL 18* | Same as above, but with large lamp house . . . | 81.00 |

*The 25-inch optical bed supplied with this outfit will accommodate lenses up to 22 inches in focus. If 20 or 22-inch focus lenses are required, substitute "20" or "22" for the numeral "18" in the above catalog number. No additional charge is made for the longer focus.

A carrying case is not regularly supplied with the large lamp house. For those outfits we can supply a special wooden case for **\$4.00** additional.

If any of the above Balopticons is desired with some lamp other than the hand-feed arc, deduct the price of the latter, **\$10.00**, and add price of illuminant desired (see "Accessories").

Double Dissolving Equipments

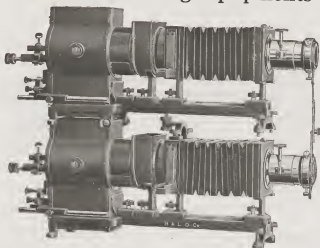


Figure 2—Double Dissolving Model D Balopticon.

A double dissolving equipment can be made up by combining two of any one of the above models and adding the iris dissolver. The price is twice that of the single equipment plus the price of the dissolver, indicated below. In ordering, use the catalog number or code word of the Model D equipment desired, preceded by the word "Double".

| Code Word | Cat. No. | Specifications | Price |
|--------------|----------|--------------------------|---------|
| <i>Deign</i> | 4490 | Iris Dissolver | \$15.00 |

Attachments

The Model D Balopticon accommodates a variety of attachments which give it a wide range of usefulness in the class room and the laboratory. These attachments are: for the projection of opaque objects; of microscopic objects; of transparent subjects held in a horizontal position; projection of the spectrum and complementary colors; and a set of accessories for projecting on the screen experiments in chemistry and physics.

Attachment for Projection of Opaque Objects

An attachment for the projection of opaque objects is readily added to the Model D by clamping the accessory to the optical bed, first removing all the standards from the latter. It will be noted from the illustration, Figure 3, that the apparatus is set up with the back of the lamp house facing the screen. For this reason the light-tight lamp house is preferable, although either style, of course, can be used.

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Figure 3—Model D Attachment for Opaque Objects.

| Code Word | Cat. No. | Specifications | Price |
|------------------|-------------|---|----------------|
| <i>Duffel</i> | 4261 | Attachment for Projection of Opaque Objects with Model D Balopticon, with $2\frac{3}{16}$ -in. diam., 12-in. focus projection lens and reversing mirror . . . | \$33.00 |
| <i>Dulcimer</i> | 4263 | Same as above, but with 4-in. diam., 15-in. focus projection lens . . . | 65.00 |
| <i>Dufrenite</i> | 4264 | Same as above, but with 4-in. diam., 18-in. focus projection lens . . . | 65.00 |

Microscope Attachments

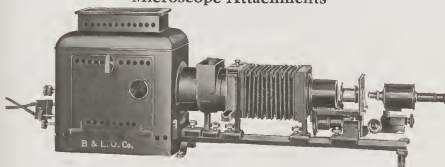


Figure 4—Model D Balopticon with Medium Microscope.

The Model D makes an excellent outfit for microscopical projection since it accommodates either the **Medium Microscope** or the **Large Projection Microscope** (see "Accessories"). The microscope is mounted on a hinged arm and the lantern slide projection lens on a swinging arm so that either may be instantly swung into the optical axis, thereby giving instant interchange between the two forms of projection.

When the Balopticon is equipped with the Large Projection Microscope, having special substage condensers for use with objectives of all powers, the best results are obtained by adding the **Aspheric Condenser** of 60 mm diameter, which is particularly designed for microscopical projection. To make its use convenient, two swinging arms, shown in Figure 5, are employed. The one next to the lamp house carries the aspheric condenser on one side and the regular lantern slide condenser on the other. The swinging arm on the lantern slide carrier support holds the third condenser of the triple system on one side and affords a clear aperture on the other. When using the microscope, the lantern slide condensers are swung out and only the aspheric condenser used. In this way the

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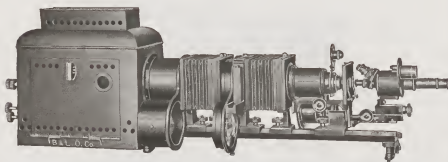


Figure 5—Model D Balopticon with Swinging Arms, Aspheric Condenser and Large Microscope.

very best illumination and definition are secured. No more than 5 amperes of current should be used with the aspheric condenser in position.

| Code Word | Cat. No. | Specifications | Price |
|------------------|--------------|---|----------------|
| <i>Dagonet</i> | 4250A | Medium Microscope , including projection eyepiece (3×), substage condenser; mounted on swinging arm; without objectives | \$45.00 |
| <i>Daker</i> | 4260 | Substage Water Cell for above | 5.00 |
| <i>Duper</i> | 4138 | Large Projection Microscope, Horizontal Type , including projection eyepiece (3×), substage water cell, three substage condensers and triple revolving nosepiece; mounted on swinging arm; without projection lens or objectives | 100.00 |
| <i>Dungeon</i> | 4139 | Same as above, but with 32, 16 and 8 mm objectives | 117.00 |
| <i>Dunter</i> | 4140 | Same as No. 4139, but with large revolving plate to accommodate six objectives | 129.00 |
| <i>Dunstable</i> | 4144 | Large Projection Microscope, Combined Horizontal and Vertical Type , including projection eyepiece (3×), substage water cell, three substage condensers, revolving plate and nosepiece for six objectives (no objectives), reversing mirror for low power objectives and a prism for use over eyepiece | 160.00 |
| <i>Dunstical</i> | 4145 | Same as above, but with 32, 16 and 8 mm achromatic objectives | 177.00 |
| <i>Dunted</i> | 4146 | Same as above, but with 72, 48 and 32 mm Micro-Tessar, and 16, 8 and 4 mm achromatic objectives | 265.00 |
| <i>Dysuria</i> | 4306 | Aspheric Condenser , 60 mm (2½ in.) diam., in mounting. (Specify outfit on which it is to be used) | 10.00 |
| <i>Dysury</i> | 4320 | Two Double Swinging Arms , one for carrying aspheric condenser and two rear condensers of triple system; other, mounted on a slide carrier support, to carry third lens of triple system, also to afford clear aperture* | 26.50 |
| | | When ordered separately | 22.50 |
| | | When ordered with Balopticon | |

*In ordering Model D Balopticon with these two standards and aspheric condenser, give catalog number of the outfit desired and specify, "with standards No. 4320 and aspheric condenser No. 4306".

Vertical Attachments

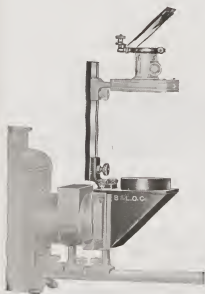


Figure 6—Vertical Attachment No. 4290 for Model D Balopticon.

upon which the glass dishes, specimens, etc., to be projected are placed.

The second type of vertical attachment, shown in Figure 7, is far more convenient and affords a much wider range of usefulness because one can change instantly from projection with this attachment to the use of lantern slides, and vice versa. Consequently the attachment may be left in position on the lantern as long as any other work undertaken does not require the additional space on the optical bed occupied by the vertical attachment.

The instrument has a dark chamber supported by two standards which fit the optical bed and are provided with clamps. Within this dark chamber is the reflecting mirror, controlled by an exterior lever as shown in the illustration. When the mirror is dropped to the 45° angle, it reflects the light up through the vertical attachment. When the mirror is turned up, it covers the condenser of this attachment, permitting an

For the projection of **transparent objects** which must be maintained in the **horizontal position** two attachments are available. The one illustrated in Figure 6 is attached to the slide carrier support by removing the bellows and substituting in the sliding ways the prism-shaped metal box which contains a reflecting mirror. The vertical bed is attached to the slide carrier support by two strong screws. The front standard of the Balopticon carrying the projection lens is removed and placed on the vertical bed together with a mirror which fits over the lens hood.

The third condensing lens in mount is removed from the back of the slide carrier support and placed over the opening in the top of the prism box. It not only converges the light on the projection lens, but, the plane side of the condenser being uppermost, it serves as a stage, 4½ inches in diameter,

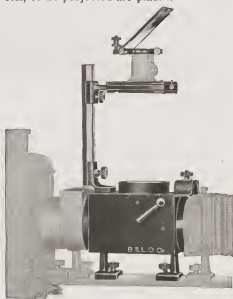


Figure 7—Vertical Attachment No. 4136B for Model D Balopticon.

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uninterrupted passage of light through to the lantern slide projection lens. The attachment is provided, of course, with an individual condensing lens, which forms the third member of the triple system for vertical projection, and with a regular quality projection lens of $1\frac{5}{8}$ -inch diameter, 10-inch focus.

| Code Word | Cat. No. | Specifications | Price |
|---------------|--------------|---|----------------|
| <i>Dale</i> | 4290 | Vertical Attachment , as described and illustrated in Figure 6 | \$15.00 |
| <i>Dipody</i> | 4136B | Vertical Attachment , including separate projection lens and condenser to permit instant interchange with lantern slide projection, as described and illustrated in Figure 7 | 42.00 |

Attachment for Projection of the Spectrum and Complementary Colors



Figure 8—Set of Accessories for Projecting Spectrum and Complementary Colors with Model D Balopticon.

Figure 8 illustrates the Model D Balopticon equipped for projection of the spectrum and complementary colors. The bellows are removed and the standard, carrying an adjustable slit, attached to the lantern bed between the slide carrier support and the front standard. The accessory optical bed, carrying the rest of the accessories, is attached to the front of the regular optical bed. If the Balopticon has the large lamp house, a set of revolving carbon holders, desirable in showing emission spectra, should be fitted to the arc lamp. Absorption and emission spectra only may be projected by using simply the adjustable slit and the prism placed before the projection lens.

| Code Word | Cat. No. | Specifications | Price |
|-------------------|-------------|---|----------------|
| <i>Daffodil</i> | 4154 | Set of Accessories for projection of the spectrum and complementary colors, consisting of supplementary optical bed, adjustable slit and standard, carbon bisulphide prism, lenses, etc. | \$45.00 |
| <i>Dafish</i> | 4156 | Pair of Special Carbon Holders with revolving plates carrying special electrodes for holding chemical salt | 15.00 |
| | | (The following set of accessories is for projection of the spectrum only) | |
| <i>Daff</i> | 4150 | Adjustable Slit | 7.00 |
| <i>Dudeen</i> | 4137 | Standard for supporting the above | 3.00 |
| <i>Deliberate</i> | 4446 | Bottle Prism (for carbon bisulphide); width of face, 60 mm; height, 90 mm | 6.00 |
| <i>Demy</i> | 4285 | Prism Support for the above | 3.00 |

Special Accessories for Projection of Chemical and Physical Demonstrations

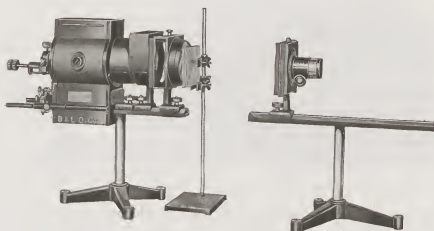


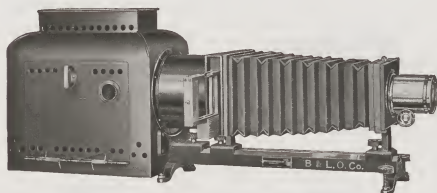
Figure 9—Accessories for Projecting Chemical and Physical Demonstrations
with Model D Balopticon.

In teaching chemistry and physics it is frequently desirable to project an experiment on the screen or to demonstrate various phenomena, such as electrolysis, precipitation, etc., before the entire class. This can best be done by placing the necessary cells, cylinders, thermometers, or whatever is required in the optical axis of a projection lantern.

Since these pieces of apparatus are often of such size and shape that they cannot be adapted to the regular lantern, we supply special standards to support the lamp house and accessories of the Model D. These give almost unlimited space for the introduction of demonstration apparatus. One standard with a short section of optical bed supports the lamp house, water cell and slide carrier support. The other standard with a long section of optical bed supports the standard with projection lens. The apparatus used in the demonstration is supported between these two sections of optical bed upon the supports which are found in any laboratory. The two standards with sections of optical bed are required in addition to the regular lantern bed.

| Code Word | Cat. No. | Specifications | Price |
|------------------|-------------|---|---------------|
| <i>Dysluite</i> | 4158 | Standard with short section of optical bed . . . | \$7.50 |
| <i>Dysluisin</i> | 4159 | Standard with 15-in. section of optical bed . . . | 8.50 |

Special Model D Balopticon for Large Plates



For the benefit of those wishing to project plates larger than the standard size lantern slides we furnish the Model D Balopticon with 6-inch diameter condensing lenses in the regular triple system with patent, ventilated mount. It is particularly desirable for the projection of **Lumiere autochrome plates**, the binding of which generally leaves, even in the standard size plates, a larger opening than the ordinary lantern will cover fully.

This outfit will project plates of any regular size up to 4 x 5 inches. It is supplied with two double slide carriers—one, our No. 4430, for standard size slides and the other for 4 x 5-inch plates. The latter is so constructed that one side will take the plate in a horizontal position and the other side in a vertical position.

This will also be found a very attractive lantern for physicists who wish to have available an unusually large beam of light for projecting physical apparatus and the like. It can be very conveniently used for such work, since the bellows and different parts can be easily removed from the optical bed and other apparatus or materials adjusted as desired.

To afford possibilities for a wide latitude of work this outfit is equipped with a 25-inch optical bed.

| Code Word | Cat. No. | Specifications | Price |
|---------------|----------------|---|-----------------|
| <i>Disbar</i> | DALS 15 | Special Model D Balopticon , as described, without water cell and with 2 $\frac{5}{16}$ -in. diam., 15-in. focus projection lens (No carrying case is supplied with this outfit.) | \$125.00 |

Home Balopticon

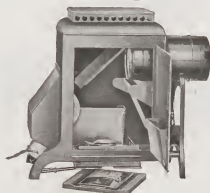


Figure 1—Home Balopticon, Simple Form for Projection of Opaque Objects Only—
Interior View, Showing Reflecting Mirrors and Watch on Object Holder.

This Balopticon has been designed to meet the popular demand for a really efficient, but inexpensive instrument, for the projection of post cards, photographs and similar objects in the home, the small classroom and the Sunday school room. It is meeting the popular demand in a most satisfactory manner and is also proving an excellent instrument for small schools that are unable to purchase more elaborate or expensive equipments. It is so simple in operation that any child can operate it, yet it far excels the ordinary post card projector in the quality of the picture produced, the illumination and its wide range of usefulness.

The apparatus is made in two forms: for the projection of opaque objects only and in **combination form** for the projection of opaque objects and lantern slides as well. In the latter model the interchange between the projection of opaque objects and of lantern slides is instantaneous, being effected by simply turning a convenient lever on the outside of the dark chamber. This lever operates an interior shield which cuts off the light from the lens for either form of projection not desired at the time.

One of the great advantages of this apparatus is that the object holder occupies a **horizontal position** against the floor of the dark chamber, rather than in the wall, as is the case with the ordinary post card projector. This permits solid objects of all kinds, such as coins, curios, etc., to be laid on the object holder and projected on the screen, while any part of a magazine can be shown without trimming or in any way mutilating it. Further, this arrangement makes the changing of opaque specimens by the operator more convenient. A single interior mirror brings the image always into **correct position**, from left to right, on the screen, so that reading matter appears unreversed—another strong feature.

The lenses are of achromatic construction, designed to give **maximum illumination** and a **flat field**. These lenses project a picture that is clearly defined to the extreme margin. The illumination is furnished by one of the new **gas-filled Mazda lamps** of 400-watt capacity. With this lamp and the use of a special, accurately corrected optical mirror, we are able to secure

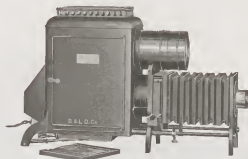


Figure 2—Combination Home Balopticon for the Projection of Both Opaque Objects and Lantern Slides.

illumination exceeding considerably that obtained from a 5-ampere arc lamp. It can be attached to any convenient lamp socket, requires no rheostat and is entirely automatic.

An **aluminum screen**, which greatly increases the brilliancy of the image, is included with each outfit.

Specifications

Base—Consists of front metal standard and metal feet at rear of dark chamber.

Dark Chamber—Of sheet metal, $13\frac{1}{2} \times 9\frac{1}{2} \times 7$ in., light-tight and well ventilated; has convenient door on right side and opening in bottom, $5 \times 5\frac{1}{2}$ in., for pictures and objects; contains fixed mirror and adjustable shield, which is swung to horizontal position when lantern slides are projected.

Illuminant—400-watt, gas-filled, Mazda stereopticon lamp mounted in connection with specially corrected glass reflector in compact metal casing attached to rear of lamp house; furnished with 15 feet of cord, plug and switch.

Projection Lens—Achromatic construction, of 4-in. diameter, 13-in. focus; mounted in well constructed spiral focusing metal tube; gives image about 4 ft. wide at projection distance of 12 ft.

Object Holder—Actuated by strong spring arm and always occupies horizontal position; supplied with two adjustable post card holders, with wooden margins, light and conveniently manipulated.

Screen—Aluminum coated, 54 in. square; mounted on plain roller.

Lantern Slide Equipment—Attached to lantern body beneath large projection lens in combination model, BRMS; consists of double condensing system, double slide carrier, No. 4430, bellows and front standard carrying a smaller achromatic projection lens, in spiral focusing mount, which gives pictures from slides corresponding in size to those from opaque objects; front standard attached to sliding rods which aid in focusing; convenient lever shifts shield to change from one kind of projection to the other.

Dimensions—Length (ready for operation)—simple model, 15 in., combination model, 24 in.; height, 15 in.; width, 7 in.

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| Code Word | Cat. No. | Specifications | Price |
|-----------------|----------------|--|----------------|
| <i>Darian</i> | BRM 13 | Home Balopticon for projection of post cards, photographs, etc., only, with 400-watt, 115-volt, gas-filled Mazda stereopticon lamp, connecting cord and plug and 4½-foot square aluminum-coated screen . . . | \$35.00 |
| <i>Daadic</i> | BRMS 13 | Home Balopticon, Combination Model , for lantern slides, as well as for post cards, etc., complete with lantern slide accessories, 400-watt, 115-volt, gas-filled, Mazda stereopticon lamp, connecting cord and plug and 4½-foot square aluminum screen . . . | 45.00 |
| <i>Danalite</i> | 5333 | Carrying Case | 2.50 |

NOTE—For classroom use, the 4½-foot screen may be considered too small, in which case we recommend the substitution of a 6x6-foot aluminum coated screen on spring roller, which may be secured with any of the above outfits for \$6.00 extra. If the larger screen is desired, it should be so specified when ordering.

For Mazda lamps on **higher voltages** we supply resistances (see "Accessories").

Special Equipment

The **Home Balopticon** has been found very useful in **Departments of English** for projecting the compositions of students upon the screen, thus enabling the class as a whole to review and criticize them more readily. In order to project as much as possible of the entire composition at one time, we are prepared to supply the Home Balopticon on special order with an opening in the bottom of the dark chamber, 5½ x 6½ inches. This area permits the projection of an entire sheet of the composition paper generally used.

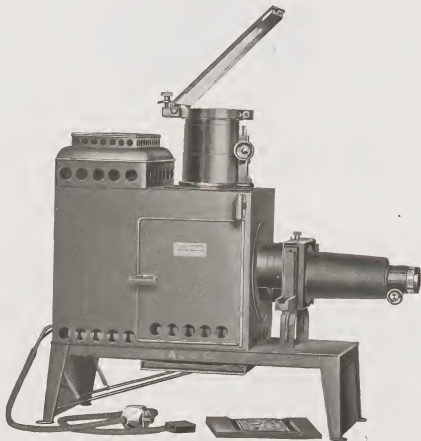
The 5½ x 6½-inch area is the largest that can be projected with this apparatus, and we offer the suggestion that the compactness, simplicity and economy of the Home Balopticon, together with the excellent opportunities which it thus affords for criticism and class review, would many times offset any inconvenience occasioned by a necessitated change in size of composition paper.

In order to project the large area with sharpness to the extreme edges, it is necessary to equip the instrument with one of our Balo projection lenses, which are of the highest quality.

| Code Word | Cat. No. | Specifications | Price |
|---------------|---------------|---|----------------|
| <i>Dacelo</i> | BRM 15 | Home Balopticon with special opening in dark chamber, 5½ x 6½ inches; with 15-in. focus Balo projection lens, 400-watt, 115-volt, gas-filled Mazda stereopticon lamp, connecting cord and plug and 8 x 8-foot aluminum coated screen on spring roller; for projection of opaque objects only | \$84.00 |

New Combined Balopticon with
1000-Watt Mazda Lamp

Model CRM



This new Balopticon is designed for the projection of **opaque objects and lantern slides** with instant interchange between the two forms. The instrument marks a new era in the projection of opaque objects on a large scale by reason of the adoption of an **incandescent lamp** as illuminant. It is the first apparatus of its kind upon the market and has proved remarkably popular from its introduction.

This **Combined Balopticon** is fitted with a specially constructed, **1000-watt**, gas-filled Mazda stereopticon lamp, which represents the highest development so far attained in this branch of illuminating engineering.

Since, unlike the arc, the lamp is enclosed, it can be brought very close to the object without danger. By means of a **mirror** with very **high optical corrections** an unusually large percentage of the available spherical candle power is utilized.

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Due to this special application of the illuminant it is possible to project an image of opaque objects with a brilliancy considerably exceeding that possible with a 35-ampere arc lamp on alternating current, and equaling that of a 20-ampere arc on direct current.

The advantages of the new lamp are obvious. It operates on only 9 amperes of current, which means a **considerable saving in current consumption** and makes it available for use on many outlets which would not have the carrying capacity to supply the high power arc lamps. Furthermore, no rheostat is required. The most striking advantage, however, is that the lamp is entirely automatic, requiring no attention whatever. It works equally well on direct or alternating current, and the disagreeable noise so characteristic of the alternating current arc is absent. A final advantage is that the quality or color of the light is very pleasing to the eye and gives a better rendition of colors than that obtained with the alternating current arc.

These lamps have no definite guarantee, but are rated to burn **200 hours**. The saving in current and carbon consumption, however, is such that a new lamp could be purchased every 50 hours of use and the cost of operation would be less per hour than that for a 35-ampere arc lamp. In other words, the Mazda lamp, including renewals, **costs about one-third as much** to operate as an A. C. arc of equal power.

This model, CRM, has been constructed especially for use with the new Mazda lamp, and the design is calculated to give the greatest possible efficiency. The lamp housing and the dark chamber have been brought together to allow the lamp to be placed as close to the object as possible. No condensers are used in illuminating the opaque object, but the specially corrected glass reflector placed back of the lamp directs the light upon the object in parallel rays.

By means of special methods of **ventilation** the temperature of the outfit is kept sufficiently low so that there is positively no danger of scorching the specimen, neither does the apparatus become uncomfortably hot for operating.

The instrument is constructed of heavy sheet metal by means of special forming tools, so that it has a pleasing appearance and the proper rigidity, at the same time being sufficiently light to make it readily portable from place to place. It is finished throughout in black enamel with a dull lustre, which is both serviceable and appropriate in such an apparatus.

The area of the opaque object that can regularly be projected is **6 x 6 inches** but much larger objects can be placed in position and shifted about so as to project any portion desired. The specimen is held in position against the bottom of the dark chamber by the object holder, which is actuated by a spring-arm. To facilitate the rapid handling of small pictures, such as post cards, we supply two adjustable carriers.

The change from the projection of opaque objects to lantern slides, or vice versa, is **made instantly** by simply turning a convenient handle on the outside of the dark chamber. This handle operates a shield in the dark chamber, which cuts off the light from the projection lens for opaque objects, or from the lens for lantern slide projection, according to the form it is desired to use, no movement of the lamp being necessary.

The lens for projecting the image of the opaque object is mounted on top of the dark chamber, together with a **first-surface mirror** which directs the light toward the screen and causes the picture to appear in **correct position from left to right**. The lens is either a 4-inch diameter, of 15 or 18 inches focus, or a 25-inch focus, with a diameter of 5 inches, the selection depending on the projection distance and the size of picture desired (see table, page 18).

The mirror supplied with the 15 and 18-inch lenses is fixed above the lens in an adjustable mount, which permits the images from both opaque object and lantern slide to be brought into coincidence on the screen. The 25-inch lens is mounted in the horizontal position with the mirror behind it and enclosed in the mounting. No adjustment of the mirror is required with this lens.

A lens is supplied for lantern slide projection which is of the proper focal length to give approximately the same size picture as that secured with the projection lens for opaque objects.

For English Classes

The projection lantern has recently been used to great advantage in English classes to project on the screen the students' compositions. In this way the work can be read and criticized by the entire class. To meet such a requirement with this instrument we have cut the regular opening for opaque objects in a plate which can be taken out by removing four screws. An opening **6x7 inches** is thus rendered available for projecting composition sheets. The plate is supplied in all instruments of this model and may be removed whenever the need arises.

Since this lantern is also an excellent one for Departments of History and Language, as well as the auditorium, and is easily taken from one room to another, the instrument should find almost continuous use.

Specifications

Base—Consists of heavy sheet metal supports, front and rear, 10½ in. wide, and carrying dark chamber at height of 5¼ in.; extreme length, 23½ in.; each foot is provided with screw hole for fastening Balopticon to table, if desired.

Lamp House and Dark Chamber—One continuous with the other; measure 9½ in. wide by 15 in. long; lamp house is 17 in. high; dark chamber, 12⅞-in.; light-tight and freely ventilated, constructed of double sheet metal walls, with an air space one inch in thickness between the two walls; roof of lamp house is fitted with our special, patented ventilator; dark chamber provided with large, light-tight door on side; convenient handle on outside of dark chamber at upper right corner controls shield by which light is cut off from opaque object lens or lantern slide lens, as desired.

Illuminant—1,000-watt, concentrated filament, gas-filled, Mazda stereopticon lamp, of special design; provided with ground and polished glass reflector, 8 in. in diam., corrected to throw a parallel beam of light upon the specimen.

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Condensing System—Our regular double system, consisting of two plano-convex lenses, 4 ½ in. in diam., mounted at the front of the dark chamber, for lantern slide projection only.

Object Holder—Square plate of sheet metal; held against opening in bottom of dark chamber by arm actuated by two strong springs; accommodates objects of varying thicknesses and automatically brings them into proper plane for projection; opening in plate at bottom of dark chamber permits area, 6 in. square, to be projected; removal of plate gives 6 x 7-in. opening.

***Slide Carrier**—Our double carrier, No. 4430, with elevating device.

Post Card Carrier—Two adjustable carriers with wooden frames, which slide in object holder.

Projection Lenses—Two of our new series of **Balo** lenses, especially corrected to give a brilliant, flat field with the Mazda lamp; provided with rack and pinion adjustment; of such relative foci as to project images of approximately equal size from opaque objects and lantern slides; lens for opaque objects fitted with first-surface mirror to direct light to screen and cause picture to appear in proper position from left to right.

Dimensions—Length, rear of lamp house to front of lens for lantern slide projection, 27 in.; height to top of mirror, 33 in.

*The quick-changing slide carrier, No. 4449, giving a dissolving effect, may be substituted for \$1.50 extra.

| Code Word | Cat. No. | Specifications | Price |
|----------------|---------------|--|-----------------|
| <i>Dyester</i> | CRM 15 | Combined Balopticon for projection of opaque objects and lantern slides, with 4-in. diam., 15-in. focus lens for opaque objects and 1 ¾-in. diam., 8-in. focus lens for lantern slides; 1000-watt Mazda stereopticon lamp | \$120.00 |
| <i>Dyete</i> | CRM 18 | Same as above, but with 18-in. focus lens for opaque objects and 1 ¾-in. diam., 10-in. focus lens for lantern slides | 120.00 |
| <i>Dyker</i> | CRM 25 | Same as above, but with 5-in. diam., 25-in. focus lens for opaque objects and 2 ⅞-in. diam., 12-in. focus lens for lantern slides | 200.00 |

N. B.—For those wishing to project **autochrome slides** with the above apparatus we recommend particularly the CRM-18 outfit, but with a special arrangement of the condensing system to increase the illumination and the substitution of a 2 ⅞-in. diam., 10-in. focus projection lens for the 1 ¾-in. diam. lens regularly supplied. These changes will be made on special order at an extra charge of **\$10.00**.

Combined Balopticon with Arc Lamp Model CRA

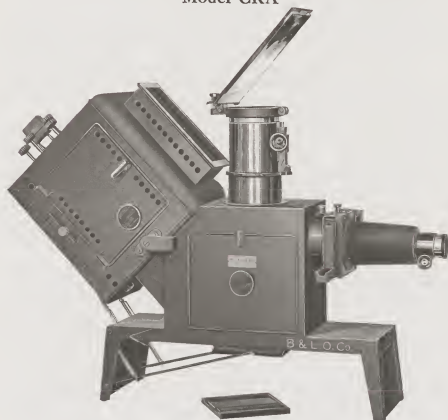


Figure 1—Combined Balopticon with Lamp House Tilted for Projection of Opaque Illustrations and Objects.

To those who have direct current and for some reason desire an arc lamp as illuminant, this model of the **Combined Balopticon** will appeal. If it is desired to use moving pictures, for instance, Model CRA with moving picture attachment, as described on a following page, makes an ideal equipment.

The **Combined Balopticon** as here offered is designed along lines that have been found by experience to be most satisfactory from the standpoints of efficiency and convenient manipulation with this type of illuminant. When projecting from opaque objects, the lamp house, with arc lamp and condensing system, is shifted to the inclined position, shown in Figure 1, so that the beam of light falls directly on the object, is collected by the projection lens and directed to the screen by the **first-surface mirror** above the lens. By this system a **brilliant illumination** is insured.

In projecting lantern slides the lamp house is placed in the horizontal position, shown in Figure 2. The light from the condensing system in the front of the lamp house passes through the dark chamber in approximately parallel pencils to

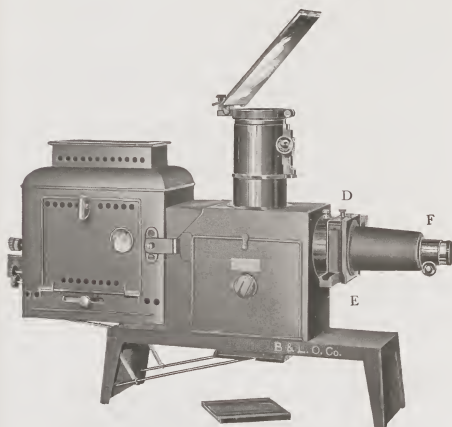


Figure 2—Combined Balopticon in Position for Lantern Slide Projection.

the condenser at D, immediately behind the slide carrier, E. This condenser properly illuminates the lantern slide, which is imaged on the screen by the lens, F.

The change from the projection of opaque objects to that of lantern slides, then, means simply the shifting of the lamp house from the inclined to the horizontal position, and vice versa. It is very easily and quickly accomplished.

This Balopticon is provided with a **horizontal object holder** for opaque objects, which is an advantage over a vertical holder since one can place on the horizontal holder objects which could not readily be placed in a vertical plane. A picture is obtained in **correct position from left to right** on the screen by the use of only one mirror, fitted over the projection lens for opaque objects.

The area of the opaque object which may be projected is **5 x 5 inches**. The object holder is so constructed that large illustrations can be shifted about to cover any position. For convenience in handling photographic prints and post cards two carriers are supplied with adjustable frames to take cards of varying widths.

The projection lenses used are our **Balo** type, producing an extremely **flat and sharply defined picture**. The lens for the projection of opaque objects is of **4-inch diameter** and either 15 or 18-inch focus, as may be required to give the size of picture desired at the given projection distance. The importance of

the large diameter is obvious when it is considered that the illumination a lens provides is directly proportional to the square of the ratio between its diameter and its focus.

The lens for lantern slide projection is of $1\frac{5}{8}$ -inch diameter and either 10 or 12-inch focus, as required to produce a picture from a lantern slide approximately equal in size to that projected from the opaque object. Both lenses are provided with a rack and pinion adjustment for focusing.

For illuminant a 90-degree **hand-feed arc lamp** is provided, which can be used on either direct or alternating current. When using 25 to 35 amperes of electricity and operating on direct current, a picture up to 11 or 12 feet wide from an opaque object can be satisfactorily illuminated. With alternating current, a picture exceeding 8 or 9 feet wide should not be attempted.

Specifications

Base—Consists of heavy sheet metal supports, front and rear, 8 in. wide and carrying dark chamber at height of $9\frac{1}{2}$ in.

Lamp House—Measures $13\frac{1}{2}$ in. long, 15 in. high and $7\frac{1}{2}$ in. wide; light-tight and freely ventilated, constructed of double sheet metal walls, with an air space between the two walls and the roof fitted with our special patented ventilator; provided with large, light-tight spring door on the side and observation windows on both sides; mounted between horizontal supports at front end and provided with handle at rear, permitting it to be easily tilted for projection of opaque objects and held rigidly in position by spring arm; conforms to the most rigorous requirements of **Boards of Underwriters**.

Illuminant—Hand-feed arc lamp for direct or alternating current.

Condensing System—Our regular triple system, with the two rear lenses mounted directly in front of the lamp house in our ventilated mount, giving a parallel beam of light in the dark chamber, and the front lens placed in front of the dark chamber immediately behind the slide carrier; diameter, $4\frac{1}{2}$ in.

Dark Chamber—Of sheet metal, light-tight, measuring $12\frac{1}{2} \times 11\frac{1}{2} \times 7$ in.; has opening in bottom for projected objects 5 in. square; provided with hinged door and observation window on right side.

Object Holder—Of square sheet metal mounted on arm controlled by two strong springs; will accommodate objects of varying thickness, and automatically bring object into proper plane of projection.

***Slide Carrier**—Our double carrier, No. 4430, with elevating device.

Post Card Carrier—Two adjustable carriers with wooden backs and frame, which fit opaque object holder.

*The quick-changing slide carrier, No. 4449, giving a dissolving effect, may be substituted for \$1.50 extra.

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Projection Lenses—Two of our new **Balo** lenses with rack and pinion focusing adjustment, of such relative foci as to project images of approximately equal size from opaque objects and lantern slides; lens for opaque objects fitted with adjustable first surface mirror.

Dimensions—Length, rear of lamp house to front of projection lens for lantern slides, 41 in.; height, 33 in. to top of mirror.

| Code Word | Cat. No. | Specifications | Price |
|---------------|---------------|---|-----------------|
| <i>Daroga</i> | CRA 15 | Combined Balopticon for projection of opaque objects and lantern slides with 4-in. diam., 15-in. focus lens for opaque projection; 1½-in. diam., 10-in. focus lens for lantern slide projection; first surface mirror for opaque projection, 90° hand-feed arc lamp; 2 post card holders | \$120.00 |
| <i>Dardan</i> | CRA 18 | Same as above, but with 4-in. diam., 18-in. focus projection lens for opaque objects and 12-in. focus lens for lantern slides | 120.00 |

Combined Balopticon with Moving Picture Attachment

A very desirable projection equipment for schools, churches, Y. M. C. A.'s, etc., is the Combined Balopticon with an attachment for moving pictures, illustrated in Figure 3. In order that instant change may be made from the projection of opaque objects or lantern slides to moving pictures and back again, we have designed a special stand with cross-rods upon which the Balopticon is mounted and moved from side to side. When moved to the right, it lines up with the moving picture mechanism, permanently mounted on the table top. The lens for lantern slide projection is carried by an arm extending from the side of the moving picture mechanism. When the Balopticon is moved to the left, it lines up with this lens and is in position for the projection of lantern slides and opaque objects. Any one of the three makes of motion picture mechanisms (Powers, Edison or Simplex) may be fitted.

The price of a complete outfit is the price of the regular Combined Balopticon, plus the prices of the moving picture mechanism and the special stand to accommodate the same. If it is desired to add the moving picture attachment to the Combined Balopticon after purchase, this may be done by returning the instrument to the factory for the special fittings required.

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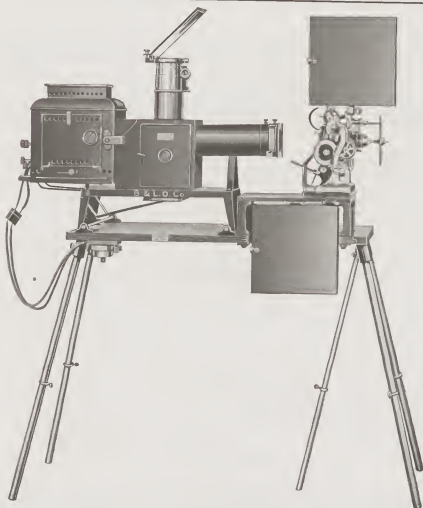


Figure 3—Combined Balopticon, CRA, on Special Stand with Moving Picture Attachment.

| Code Word | Cat. No. | Specifications | Price |
|-------------------|-------------|--|-----------------|
| <i>Dytane</i> | 4700 | Powers No. 6a Mechanism complete with 12-in. upper and lower film magazine with take-up device, automatic fire shutter and lens | \$188.00 |
| <i>Dyte</i> | 4705 | Edison Type D Mechanism complete with magazine for 12-in. reels and with take-up device, automatic fire shutter and lens | 172.00 |
| <i>Dyspnea</i> | 4706 | Edison Exhibition Mechanism in oak cabinet with upper and lower film magazines for 12-in. reels, automatic fire shutter and lens | 130.00 |
| <i>Dysphagic</i> | 4707 | Simplex Mechanism complete with 16-in. upper and lower film magazines, take-up device and 14-in. reels, automatic fire shutter and lens, and film re-winder | 238.00 |
| <i>Dynastidan</i> | 4715 | Special Stand , arranged as shown in Figure 3, including knife switch and connecting wires | 30.00 |

NOTE.—With all of the above mechanisms we supply one of our regular, high grade motion picture projection lenses.

The Universal Balopticon

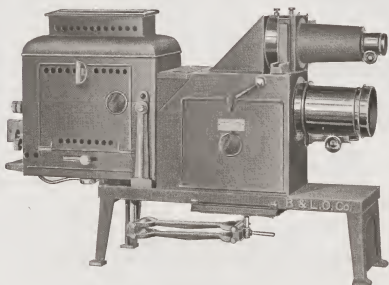


Figure 1—Universal Balopticon ERA 15 in Position for Lantern Slide Projection.

The **Universal Balopticon** has proved very popular wherever a combination apparatus of extreme rigidity and general adaptability is desired. The base instrument projects lantern slides and opaque objects, up to 6 inches square. It is widely used in the science departments of colleges and high schools, however, because of the attachments it readily accommodates for the efficient projection of a wide range of subjects: microscopical objects, large, transparent objects held in a horizontal plane, the spectrum and complementary colors and physical or chemical phenomena. These attachments may be added at any time and are so arranged that instant interchange is provided between the different kinds of projection, the interchange between lantern slides and opaque objects being accomplished by raising or lowering the lamp house as required.

In addition to these possibilities, an attachment for the projection of moving pictures may be added upon special order.

Lantern Slide Projection

For work with lantern slides the lamp house remains in the horizontal position, as shown in Figure 1. The projection lens for lantern slides is mounted on top of the dark chamber with the slide carrier support and the third lens of the triple condensing system. The first two lenses of this system are mounted in the front of the lamp house to collect the rays proceeding from the arc.

In the dark chamber is a mirror in mounting so inclined as to reflect the light coming from the arc lamp up to a second mirror parallel to the first and mounted back of the projection lens on top of the dark chamber. The second mirror directs the light through the slide and projection lens to the screen. The position of the mirror in the dark chamber is indicated by the exterior lever over the door, this lever being used to shift the mirror when it is desired to change to microscopical projection.

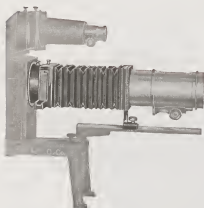


Figure 2—Accessories for Projecting Lantern Slides with Long Focus Lenses.

It is sometimes desired to project lantern slides at a greater distance than is possible with the regular 8 or 10-inch focus projection lens. For this reason we supply a set of accessories by means of which the projection lens for opaque objects, which is of 15 or 18-in. focus, may be utilized for the purpose. These accessories consist of a 4½-inch condensing lens, which completes the triple system, a slide carrier support (the regular slide carrier being used), bellows and front standard to support the projection lens, Figure 2. The accessory optical bed is required to support the front standard carrying the lens.

The mirror in the dark chamber is turned to the horizontal position, giving a direct path of light from arc lamp to screen. With this arrangement it is possible to project a distance of 75 or 80 feet, thus, with small additional expense, making the apparatus available for long distance lantern slide projection in large halls and auditoriums.

Projection of Opaque Objects

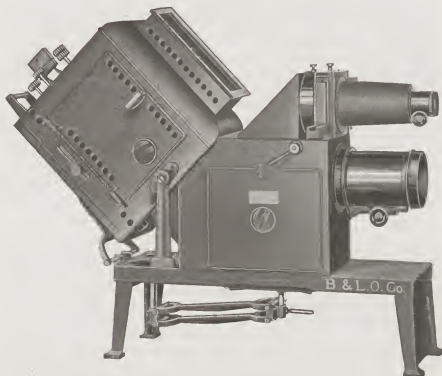


Figure 3—Universal Balopticon ERA 15 in Position for Projection of Opaque Objects.

When projecting opaque objects, the maximum illumination obtainable from a single light source is obtained by direct lighting of the object without intermediate reflection and by decreasing the distance between specimen and illuminant. This is accomplished by tilting the lamp house as in Figure 3, the strong spring catch holding it in position. This throws the light directly down on the object, which is held against the opening in the floor of the dark chamber by the strong springs of the object holder. There is only one mirror reflection, that by which the light passing from the object through the projection lens is directed toward the screen. This reflection at the same time causes the image to appear in **correct position**, from left to right. This reflection is caused by the mirror in the dark chamber mounted on lower side of mirror carrier used in lantern slide projection.

Vertical Attachment

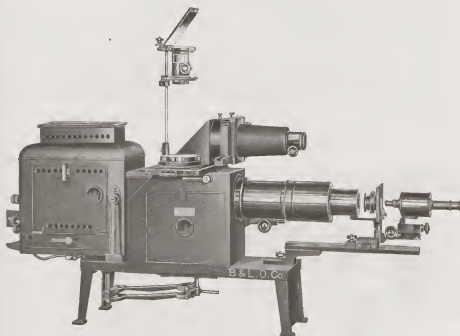


Figure 4—Universal Balopticon, ERVA 15, Showing Vertical Attachment and Medium Microscope, 4250 U.

With the addition of the vertical attachment organisms in water, physical, chemical and biological demonstrations, or any subjects which must be placed in a horizontal position, can be projected on the screen. This equipment, shown in Figure 4, is mounted on one end of a rectangular plate, which slides on metal rods over the opening in the top of the dark chamber.

The mirror box and equipment for lantern slides is mounted on the other end of this plate, and to change from one to the other it is simply necessary to shift the plate by means of a convenient handle. The position of the movable mirror carrier within the dark chamber is the same for either lantern slide, opaque or vertical projection because of its two reflecting surfaces.

The vertical equipment consists of a $4\frac{1}{2}$ -inch plano-convex condensing lens, mounted in the sliding plate with the plane side up, to serve also as a stage for the subject, and a projection lens with reversing mirror carried above it on a vertical rod.

Microscopical Projection

For microscopical projection (Figure 4) provision is made for attaching a carefully planed optical bed to the front of the base by means of a strong but convenient set screw. The microscope with mounting is then attached to the bed in front of the large projection lens, which serves as a condenser. The movable mirror is raised to permit a free passage of light. If it is desired to change to the projection of opaque objects, the microscope can be quickly swung out of the path of light by means of a swinging arm.

We list two microscopes for use on this Balopticon: our Medium Microscope, with simple substage condenser, and our Large Projection Microscope (Horizontal Type), with three substage condensers. The former is most efficient when used with medium power objectives, while the Large Microscope is equally efficient with all powers, low, medium and high. With either one there is supplied an extension sleeve with supplementary condenser, which serves in connection with the projection lens for opaque objects as a substitute for the front lens of the triple condensing system.

Spectroscopical Projection

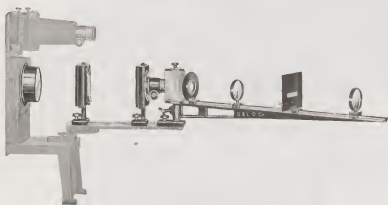


Figure 5—Accessories for Projecting Spectrum and Complementary Colors with Universal Balopticon.

The apparatus for the projection of the spectrum and complementary colors, shown in Figure 5, consists of a supplementary bed, an adjustable slit, carbon bisulphide prism, holder to take deflecting wedges, and condensing and projecting lenses. An absorption spectrum is projected by placing the absorbing medium in the path of light before the slit, the emission spectra by introducing various chemical salts into the arc. A pure spectrum will be obtained every time if the special revolving carbon holders are fitted to the arc lamp, permitting new carbons to be used with each salt introduced.

Accessories for Projection of Cells and Tubes

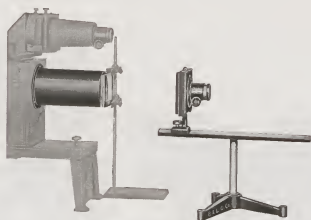


Figure 6—Accessories for Projecting Cells and Tubes with Universal Balopticon.

This set of accessories is designed for use in the chemical and physical laboratories for projecting any demonstrations which may be conducted with the aid of cells, test-tubes, thermometers, etc. It consists of a $4\frac{1}{2}$ -inch condensing lens with adapter, which is substituted for the projection lens for opaque objects, a separate optical bed on support and a standard upon which is mounted the projecting lens regularly used for lantern slides.

The apparatus to be projected is carried directly in front of the condensing lens on one of the supports or standards to be found in every laboratory. With this arrangement unlimited space is provided for placing in position of cells, burrettes, cylinders, etc., as may be required for showing the phenomena desired. When this apparatus is to be used, a table with extra long top is required to accommodate the projection lens and its optical bed. For this purpose we recommend our Balopticon Table No. 4253B. (See "Accessories".)

In order that the image may not be inverted we recommend the use of the special erecting prism No. 4441, which fits over the front of the projecting lens.

If one is satisfied with the smaller ($3\frac{1}{4}$ -inch) beam of light obtained with the opaque object projection lens, this lens may be used and the cost of the extra condensing lens saved.

Moving Picture Projection

The special stand illustrated in Figure 7, permits the projection of moving pictures and affords instant interchange between this and the other forms of projection. The Balopticon is carried on two lateral tracks upon which it can be moved from one side of the stand to the other. The supplementary optical bed, otherwise attached to the base of the instrument when it is desired to accommodate a microscope or other attachments, is carried on supports beside the moving picture mechanism. This bed carries all accessories regularly accommodated by the Universal. When changing from moving pictures to any other form of projection, the Balopticon is simply slid over until it lines with the supplementary optical bed, and vice versa.

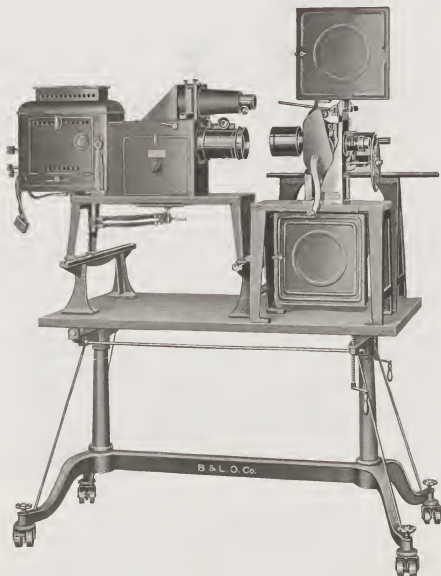


Figure 7—Universal Balopticon on Special Stand with Moving Picture Attachment.

Specifications

Base—Of cast iron, 25 in. in length; carried at height of 7 in. from table by two cast iron supports of 11-in. spread with elevating screws front and rear.

Lamp House—Measures $13\frac{1}{4}$ in. long, $13\frac{1}{2}$ in. high and $7\frac{1}{2}$ in. wide; light-tight and freely ventilated, constructed of double sheet metal walls, with an air space between the two walls and the roof fitted with our special patented ventilator; provided with large, light-tight spring door on the side and observation windows on both sides; mounted between uprights at front end and provided with handle at rear, permitting it to be easily tilted for opaque projection and held rigidly in position by strong spring arm; conforms to the most rigorous requirements of **Boards of Underwriters**.

Illuminant—Hand-feed arc lamp for direct or alternating current.

Condensing System—Consists of two rear lenses of our triple system, 6-in. diameter, in ventilated mount directly in front of lamp house, rendering light approximately parallel in dark chamber, and a plano convex lens placed in front of the mirror box for lantern slide work, completing triple system.

Object Holder—Round, of heavy metal, mounted on double arm with spring hinge at each end and handle at holder end; the whole adjustable for height on a grooved vertical standard and provided with set screw; will accommodate objects of widely varying thickness and size, the holder always remaining parallel to base and automatically bringing object into proper plane of projection; dark curtain in front of opening prevents light from flooding room when object is being changed.

Slide Carrier—Quick changing slide carrier so arranged that the slides can all be inserted from one side.

Post Card Carrier—Two adjustable holders with wooden backs and frame which fits securely over opening in bottom of dark chamber.

Projection Lenses—Two of our **Standard** lenses with rack and pinion focusing adjustment, that for lantern slides regularly of 8-inch focus, $1\frac{5}{8}$ -in. diameter, and that for opaque work of 15-inch focus, 4-in. diameter; lenses of other foci may be substituted if so specified.

Dimensions—Length over all, 38 in.; height, 24 in.

Vertical Equipment—Regularly furnished with Universal Balopticon No. 4186 only, but can be ordered separately and easily added to No. 4185; consists of a rectangular metal plate, $6\frac{1}{4}$ x 12 in., with circular opening at either end; over one end is mounted a plano convex condensing lens with plane side up, to complete triple condensing system for vertical projection and provide stage upon which to work; upright grooved standard near opening carries 10-in. focus, $1\frac{5}{8}$ -in. diameter projection lens and mirror for vertical work; over other opening provision is made for mounting mirror box with lantern slide equipment; for quick transformation from one form of projection to the other entire plate slides on metal rods and is operated by convenient handle.

Bausch & Lomb Optical Company

Price List

| Code Word | Cat. No. | Specifications | Price |
|------------------|----------------|---|-----------------|
| <i>Durbar</i> | ERA 15 | Universal Balopticon, complete for projection of lantern slides and opaque objects, as described, with 4-in. diam., 15-in. focus projection lens for opaque objects and 1½-in. diam., 8-in. focus projection lens for lantern slides | \$160.00 |
| <i>Durant</i> | ERVA 15 | Same as above, but with Vertical Attachment , as described | 175.00 |
| <i>Durance</i> | ERA 18 | ERA 15, but with 4-in. diam., 18-in. focus projection lens for opaque objects and 1½-in. diam., 10-in. focus projection lens for lantern slides | 160.00 |
| <i>Duration</i> | ERVA 18 | ERA 18, but with Vertical Attachment , as described | 175.00 |
| <i>Dzeggetai</i> | 4180 | Set of Accessories for adapting opaque object projection lens to lantern slide projection ; consists of 4½ in. diameter plano-convex condensing lens in mounting slide carrier support, bellows and front standard (optical bed No. 4141 must be used with this apparatus) | 10.00 |
| <i>Durative</i> | 4141 | Optical Bed , carefully planed, 15 in. long; attaches easily to front end of base of Universal Balopticon to accommodate microscope | 5.00 |

Microscope Attachments

| Code Word | Cat. No. | Specifications | Price |
|----------------|---------------|--|-----------------|
| <i>Dupeur</i> | 4138 U | Large Projection Microscope , as described including projection eyepiece (3×), substage water cell, three substage condensers and triple revolving nosepiece; mounted on swinging arm, without projection lens or objective (optical bed No. 4141 must be ordered with this apparatus) | \$100.00 |
| <i>Dungeur</i> | 4139 U | Same as No. 4138, but with 32, 16 and 8 mm objectives | 117.00 |
| <i>Daisu</i> | 4250 U | Medium Microscope with projection eyepiece and substage condenser, mounted on swinging arm; without objectives (optical bed No. 4141 must be ordered with this microscope) | 45.00 |
| <i>Daker</i> | 4260 | Substage Water Cell for medium microscope | 5.00 |

Vertical Attachment

| Code Word | Cat. No. | Specifications | Price |
|----------------|-------------|--|----------------|
| <i>Duramen</i> | 4187 | Vertical Attachment , as described, (see page 61) | \$15.00 |

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Apparatus for Projection of the Spectrum and Complementary Colors

| Code Word | Cat. No. | Specifications | Price |
|--------------------|---------------|--|----------------|
| <i>Daffodiller</i> | 4154 U | Set of Accessories for projection of the spectrum and complementary colors , consisting of condensing lens, in mounting to fit front of dark chamber, supplementary optical bed, adjustable slit and standard, and front standard and front board with flange, carbon bisulphide prism, lenses, etc. (optical bed No. 4141 must be used with this apparatus) | \$50.00 |
| <i>Daffish</i> | 4156 | Pair of Special Carbon Holders with revolving plates carrying special electrodes for holding chemical salts | 15.00 |

Apparatus for Projection of Cells, Tubes, etc.

| Code Word | Cat. No. | Specifications | Price |
|----------------|-------------|--|----------------|
| <i>Dysmite</i> | 4160 | Set of Accessories for projection of cells, test-tubes, thermometers, etc. , consisting of 4½ in. plano-convex condensing lens with adapter, optical bed on support and standard for projection lens (Balopticon Table No. 4253B recommended for use with this outfit) | \$14.00 |
| <i>Decide</i> | 4441 | Trapezoidal Erecting Prism in mount to fit over 1½-in diam. lens | 20.00 |

Moving Picture Attachment

The price of a complete outfit is the price of the regular Universal Balopticon, plus the prices of the moving picture mechanism and the special stand to accommodate same. If it is desired to add the moving picture attachment to the Universal Balopticon after purchase, this may be done by returning the instrument to the factory for the special fittings required.

| Code Word | Cat. No. | Specifications | Price |
|------------------|-------------|---|-----------------|
| <i>Dytane</i> | 4700 | Powers No. 6a Mechanism complete with 12 in. upper and lower film magazine with take-up device, automatic fire shutter and lens | \$188.00 |
| <i>Dyte</i> | 4705 | Edison Type D Mechanism complete with magazine for 12 in. reels and with take-up device, automatic fire shutter and lens | 172.00 |
| <i>Dyspnea</i> | 4706 | Edison Exhibition Mechanism in oak cabinet with upper and lower film magazines for 12 in. reels, automatic fire shutter and lens | 130.00 |
| <i>Dysphagic</i> | 4707 | Simplex Mechanism complete with 16 in. upper and lower film magazines, take-up device and 14 in. reels, automatic fire shutter and lens, and film rewinder | 238.00 |
| <i>Dyvour</i> | 4710 | Special Stand arranged as shown in Figure 7, including knife switch and connecting wires | 75.00 |

NOTE—With all of the above mechanisms we supply one of our regular, high grade motion picture projection lenses.

Convertible Balopticon

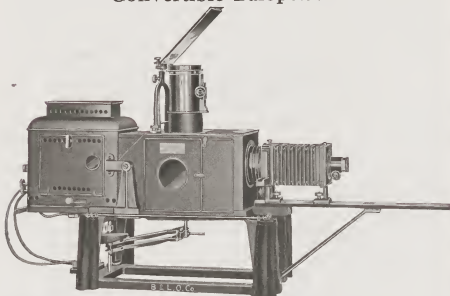


Figure 1—Convertible Balopticon in Position for Lantern Slide Projection.

The **Convertible Balopticon** is, in reality, what its name implies: convertible in every sense of the word. In its simplest form it is arranged for the projection of opaque objects up to $8 \times 10\frac{1}{2}$ inches and of lantern slides with quick interchange from one to the other by the shifting of the lamp house (with arc lamp and condensing system) from the inclined to the horizontal position, and vice versa.

This apparatus is constructed, like our other Balopticons, on what might be termed the **unit system**. To the base unit may be added other units or attachments for the projection of **microscopic objects**; projection of large transparent objects such as **brain sections**, **X-ray plates**, etc., held in a **horizontal plane**; projection of **anatomical specimens in museum jars**; projection with **polarized light**; projection of the **spectrum** and **complementary colors**; projection of **motion pictures** by a special construction.

These attachments are so constructed that, with one exception, they can all be added to the base instrument, and the result is an apparatus complete for as many different forms of projection as may be desired—with **instant interchange** from one to the other. This quick interchange is of importance in any apparatus intended for use in the class room or laboratory, since it renders immediately available a wide range of illustrative materials and permits one to cover a great deal of ground without delay or inconvenience.

Furthermore, **maximum efficiency** is attained with all these different forms of projection. By this statement we mean that if we were to construct apparatus particularly designed for any one of the forms enumerated, no better results, for all practical purposes, could be obtained than those possible with the **Convertible Balopticon**.

This unit system of construction, therefore, enables us to make up a combination outfit that will meet any demand—from that of departments wishing to

project lantern slides and opaque objects only to the Department of Biology, requiring the microscope and vertical attachments, and the Departments of Physics and Chemistry, where projection with polarized light and the projection of the spectrum is desired in addition to that of opaque objects and lantern slides. This system of manufacture will also be appreciated by those who wish to add attachments from time to time as need arises, or who are unable for lack of funds to purchase a complete outfit at once.

In our constant endeavor to perfect our apparatus we have introduced several new features and refinements in the latest model of the Convertible Balopticon. Chief among these are:—

1. **Lever with quick acting cam for arresting the object holder at any point between base of instrument and bottom of dark chamber** (see Figure 3).
2. **Two doors on right side of dark chamber, giving an opening the size of the entire side of the chamber for placing large objects, such as anatomical specimens, in position.**
3. **Set of reflectors for projecting anatomical specimens in vertical museum jars.**
4. **New design of carbon holder on arc lamp, making better electrical contact and keeping carbons in accurate alignment.** The magnetic coils with which we equip this lamp have proved in practice to be very efficient in reducing the "blowing" of the arc and make the light much easier to control on high amperages.

We also desire to lay emphasis upon two other features which, while not new with this model of the Convertible, are nevertheless lacking in other projection machines now on the market. These are:

1. **All adjustments are made from the outside of the apparatus, and**
2. **All objects of ordinary size, such as books, etc., can be placed upon the object holder without opening the doors of the dark chamber.**

Lantern Slide Projection

For work with lantern slides the lamp house remains in its horizontal position as shown in Figure 1, and the beam of light follows an uninterrupted path, as indicated by the dash lines in Figure 2. The accessories for lantern slide projection are carried on the optical bed directly in front of the dark chamber and consist of a plano-convex condensing lens—which completes the triple condensing system and forms an image of the arc at the diaphragm plane of the projection lens—a double, quick changing slide carrier in support, a front standard carrying a projection lens and a bellows connecting front standard with slide carrier support to prevent light from escaping into the room.

This apparatus requires no reflectors for lantern slide projection; consequently, **maximum illumination** is attained. This feature is of special importance where autochrome plates are to be projected, since these require all the illumination possible.

Autochrome slides are coming more and more into use, especially in medical school work, and many makers of these plates find it advantageous to make them

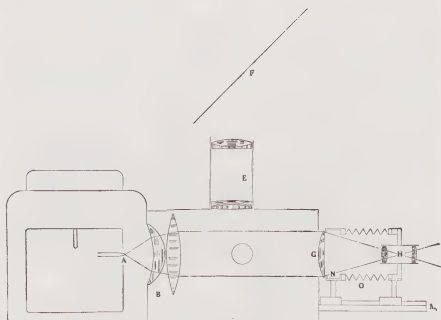


Figure 2—Diagram Showing Path of Light for Lantern Slide Projection: A = Arc; B = Rear Lenses of Condensing System; C = Front Lens of Condensing System; H = Projection Lens for Lantern Slides; M = Optical Bed; N = Slide Carrier Holder; O = Bellows.

in 4 x 5 or 5 x 7-inch sizes. For these we have arranged a special set of lantern slide accessories with an 8-inch diameter condenser which fully illuminates these large sizes.

Projection of Opaque Objects

Appreciating the growing importance of the projection of opaque objects and illustrations in educational work, our Technical Bureau has made this type of projection a special feature of the Convertible Balopticon. The lamp house is inclined, as shown in Figure 3, and an exceptionally brilliant image of the object is obtained since this arrangement gives the **maximum illumination** obtainable from a single light source. The light source is brought as close to the object as is practicable, and the light is thrown directly onto the object. The path of the light is shown in Figure 4. There is only one mirror reflection, by which the light is directed toward the screen and the image caused, at the same time, to appear in **correct position** from left to right on the screen. The lamp house is easily tilted as shown and held rigidly in place by a strong spring arm.

A wide range of opaque material can be utilized with this instrument. The object is always held in a **horizontal position**, and the design of the base and object holder is such as to permit materials of greatly varying size and shape to be projected. To prevent light from escaping into the room when large objects are being projected the Convertible is supplied with velvet curtains suspended from the bottom of the dark chamber on either side of the base. A metal shield at the front of the base prevents the screen from being flooded with light when changing objects. The curtains are hung on rods and can be slid out of the way or entirely removed when not in use.

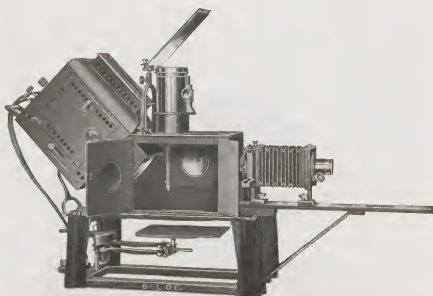


Figure 3—Convertible Balopticon in Position for Projection of Opaque Objects.

The **strong tension spring** of the object holder will hold the pages of an open book or magazine flat against the opening in the bottom of the dark chamber, while convenient doors in the side of the chamber permit one to place smaller objects in position.

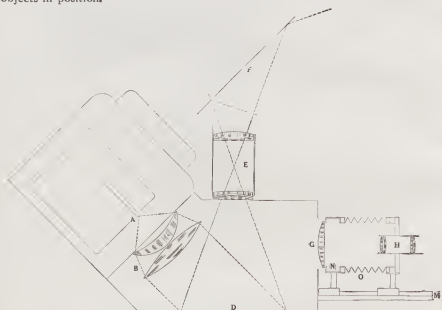


Figure 4—Diagram Showing Path of Light for Opaque Projection: A = Arc; B = Rear Lenses of Condensing System; D = Opaque Object; E = Projection Lens for Opaque Objects; F = Mirror.

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As there are many occasions when objects of considerable thickness, such as pieces of apparatus, anatomical specimens and the like, will be placed on the object holder, a cam actuated by a lever has been fixed to the support so that the object holder can be quickly lowered and left in **fixed position** at any point, thus bringing the upper surface of the object to a level with the bottom of the dark chamber for easy focusing, Figure 3. When at the lowest point of this adjustment, the object holder is 6 inches below the floor of the dark chamber. The plane of illumination, and therefore its intensity on the object, is the same for all distances from the screen as focusing is accomplished by moving the projection lens to and from the object.

For the convenient projection of post cards and small prints we supply with each outfit a frame and **two adjustable holders**. The frame fits over the opening in the bottom of the dark chamber, and the holders are very easily manipulated.

The new Convertible has a maximum opening in the bottom of the dark chamber of **8 x 10½ inches**. This opening is intended for use only when placing large trays containing anatomical specimens, etc., in position. When projecting cuts, diagrams and the like, an area **8 inches square** is the largest we recommend, and we provide a diaphragm with such an opening to fit into a slot in the bottom of the dark chamber. As it is often desired to project illustrations and objects of smaller sizes than this, we furnish with each outfit two other diaphragms with square openings of 6 inches and 4 inches, respectively.

The first two lenses of the triple condensing system are mounted directly in front of the lamp house and constitute a suitable system for projection of opaque objects, giving a beam of light in the dark chamber of sufficient diameter to cover the large area to be projected.

When using **smaller areas**, the arc lamp can be drawn away from the condensing system so that the beam of light just covers the area to be projected. This means **increased illumination**, since the same quantity of light is spread over a smaller area. The adjustment of the arc to and from the condensers is easily controlled from the exterior of the lamp house. It is only necessary to loosen the clamping screw at the bottom of the lamp house and shift the lamp backward or forward by adjusting rods at the rear.

For opaque object projection we offer four different projection lenses for use on this instrument. Their corrections for astigmatism and **flatness of field** are superior to anything heretofore produced for the purpose.

Three of these lenses are of the same construction and have focal lengths of 15, 18 and 25 inches, with a corresponding ratio between aperture and focus of F:4.0, F:4.8 and F:5.0, respectively. The fourth lens is one of 15-inch focus, with a ratio between aperture and focus of **F:3.5**, so that this lens has the **greatest light transmitting power** of any, while its covering power leaves nothing to be desired so far as flatness of field and definition are concerned.

All of these lenses, with the exception of the 25-inch focus, are mounted on the top of the dark chamber in a vertical position. A reversing mirror is carried over the front of the lens on a separate support. The mirror is **silvered on the first surface**, giving the nearest approach to a totally reflecting medium that can

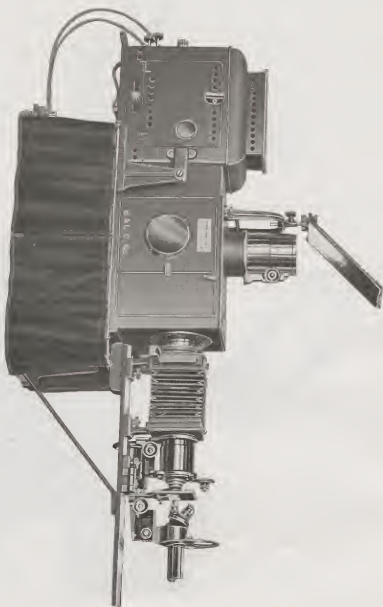


Figure 5.—Convertible Biaphticon with Large Projection Microscope, Horizontal Type.

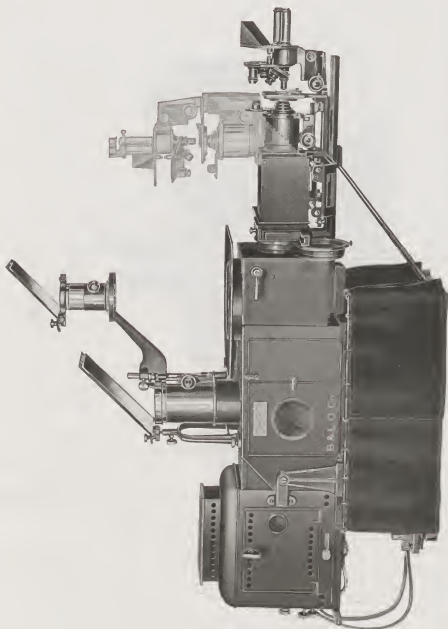


Figure 6—Convertible Balopticon with Large Projection Microscope, Combined Horizontal and Vertical Type, and Special Vertical Attachment.

be obtained. It is protected by a neat, sliding cover of hard wood and is adjustable so that the angle of reflection can easily be changed and the position of the image shifted as desired. This enables one to raise the image, as is often necessary, to clear the heads of those seated close to the screen.

On account of its long focus it is not practical to mount the 25-inch focus lens in vertical position with the reversing mirror above it; this lens is fitted to the front of a metal, prism-shaped box carrying the reversing mirror, and the whole mounted as one piece on the top of the dark chamber, the lens being in the horizontal position in front of the mirror.

All of the lenses for the projection of opaque objects are provided with rack and pinion adjustment for ordinary focusing and also with a spiral focusing adjustment to give greater latitude at varying distances from the screen.

Projection with Vertical Museum Jars

For the projection of specimens in vertical museum jars, we have devised a set of mirrors by which the specimen is made to appear on the screen in correct position. The mirrors are readily placed in proper position in the dark chamber and those who have used them for projecting anatomical specimens have been highly gratified with the results obtained.

Microscopical Projection

We recommend for use on the Convertible Balopticon our **Large Projection Microscope** of either the horizontal type, Figure 5, or the combined horizontal and vertical type, Figure 6, because of the unusually high efficiency in point of illumination and the wide range of objectives that may be used. (For detailed description see "Accessories.")

Either type attaches rigidly to the optical bed and instant interchange may be made between microscopical and the ordinary forms of projection. We have made extensive experiments with the projection microscope and are confident that these two instruments represent the highest type of microscope attachment on the market.



Figure 7—Diagram of Illuminating System for Microscopical Projection with High Power Objectives: L=Light Source; C=Condensing System; L'=Inverted Image of L at Plane of Diaphragm; E=Substage Condenser; S=Object Slide; C'=Image of Third Condensing Lens in Plane of S.

The use in projection work of **high power objectives**, as the 4 mm and 3 mm, has been rather impractical in the past. We have adopted a modification of the Köhler illuminating system for this new Convertible Balopticon, however, by means of which entirely **satisfactory results** can be obtained with such objectives.

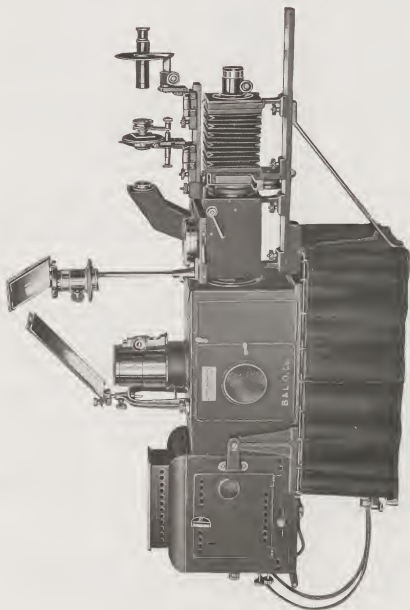


Figure 8—Convertible Balopticon with Combined Vertical and Polariscopes Attachment.

The path of light for this system is shown in Figure 7. To obtain this the condensing lens directly back of the lantern slide carrier, which lens is mounted in a swinging arm, is thrown out of the optical axis, and a small double convex lens, mounted in the dark chamber, is swung into position directly in front of the large rear condensers. This produces a gradually converging pencil of light, which finally forms a large image of the arc at the diaphragm plane of the substage condensers and fully fills the aperture of the high power condenser. With the improved substage condensers this arrangement is used for all the different powers of objectives that may be required.

Microscopical Projection with Polarized Light

For those who wish to project petrographical or chemical specimens with polarized light, we have arranged a set of accessories to be used with either of the microscopes mentioned above. (See "Accessories.")

Combined Vertical and Polariscopes Attachment

An attachment of this kind will be of great service in a Department of Physics, because one can demonstrate both parallel and convergent polarized light and use the attachment as well for demonstrating various physical phenomena, such as the lines of magnetic force, etc., or for projecting any transparent objects which must be held in a horizontal plane.

The **Combined Vertical and Polariscopes Attachment**, Figure 8, consists of a dark chamber with an adjustable interior mirror which can be set at an angle of 52° for polariscopical projection, or at an angle of 45° for vertical projection. A plate which slides across the top of this dark chamber carries the reflecting box and plates for producing polarized light and the optical system used with the vertical attachment. The change from one form of projection to the other is made by shifting the mirror in the dark chamber and sliding the plate on top of the chamber into the desired position. The light is then reflected by the mirror up through the vertical attachment or the polariscopes attachment, according as one or the other has been slid into position.

For projection with the vertical attachment we have mounted a $4\frac{1}{2}$ -inch diameter plano-convex condensing lens in the sliding plate with a projection lens and reversing mirror carried above it on a vertical rod. This condensing lens is mounted with the plane side up to serve also as a stage. At the other end of the sliding plate is the box containing the reflectors and polarizing plates of the polariscopes. When projecting opaque objects the vertical attachment is withdrawn from the path of the large projection lens by means of the sliding plate, and the supports carrying the body tube and revolving stage of the polariscopes are hinged so that they, too, can be turned away from the path of light.

Some departments may have use for only the polariscopes attachment on this outfit; others may wish to use only the vertical feature. For this reason we supply the attachment with the polariscopes or the vertical equipment only, if desired. (See price list.)

Special Vertical Attachment

In order to meet the demand for some means of projecting X-ray plates, large sections, such as brain sections, and other large transparencies without reducing them to ordinary lantern slides, we have devised this special attachment which

makes it possible to project areas up to 8 inches in diameter, Figure 6. It is arranged to be fitted on the optical bed directly before the main dark chamber, the front of which is removed to permit the full 8-inch diameter beam of light to enter the attachment.

A movable mirror in the secondary dark chamber reflects the light upward, where it is collected by a large plano-convex condensing lens placed in a horizontal mount on the top of the secondary chamber. Around this condensing lens is constructed a cloth-covered platform, on which the transparency may be placed. This permits the specimen to be shifted so that any particular area can be projected.

The projection lens and reversing mirror are mounted on a swinging arm so that they can be readily turned out of the path of light for the projection of opaque objects.

Spectroscopical Projection



Figure 9—Set of Accessories for Projection of the Spectrum and Complementary Colors.

The set of accessories for projection of the spectrum and complementary colors is very readily manipulated. The apparatus consists of a supplementary bed attachable to the optical bed, an adjustable slit, carbon bisulphide prism and a set of lenses with which either the spectrum or complementary colors can be projected, Figure 9. Both absorption and emission spectra can be shown with this attachment, the former being demonstrated by simply placing the absorbing media in the path of light in front of the slit, while the latter is shown by introducing various chemical salts into the arc. Special revolving carbon holders which can be fitted to the arc lamp are recommended so that new carbons can be used with each new salt, thus securing a pure spectrum in each case.

Moving Picture Projection

We have designed the special stand with fittings, as shown in Figure 10, to provide an efficient means of projecting moving pictures in connection with the opaque object, lantern slide and other forms of projection available with the Convertible Balopticon. Two tracks running from side to side across the top of the stand support the Balopticon. On one front corner of the stand is a supplementary table carrying the moving picture attachment (either Edison, Powers or Simplex). The optical bed which is ordinarily attached to the front of the base of the Convertible is, with this arrangement, carried by two supports mounted on the table top and is independent of the Balopticon. All of the accessories, such as the projection microscope, etc., that would be used on any regular Convertible can be attached to this bed.



Figure 10—Convertible Balopticon on Special Stand
with Moving Picture Attachment.

When projecting lantern slides, opaque objects or using any of the other attachments, the body of the lantern is in the position indicated by Figure 10—lined up with the optical bed. When changing from any of these forms of projection to moving pictures, all that is necessary is to slide the Balopticon over until it lines up with the moving picture mechanism, and vice versa. Quick interchange is thus provided between moving pictures and all other forms of projection available.

A stand of such construction as that shown here is necessary to give the requisite stability and to prevent vibration when running the moving picture mechanism.

Specifications of Balopticon

Base—Cast iron frame of rectangular shape, $11\frac{1}{2}$ in. wide, with rigid supports at either end carrying dark chamber and optical bed at height of $10\frac{1}{2}$ in.

Optical Bed—Of lathe type, carefully planed, accommodating supports for attachments which may be adjusted as desired and rigidly clamped; length of optical bed proper, 25 in.; entire bed, including space occupied by dark chamber, 47 in. long, affording wide range of applicability.

Lamp House—Measures $13\frac{1}{2}$ in. long, 15 in. high and 8 in. wide; light-tight and freely ventilated, constructed of double sheet metal walls, with an air space between the two walls and the roof fitted with our special, patented ventilator; provided with large, light-tight spring door on the side and observation windows on both sides; mounted between uprights at front end and provided with handle at rear, permitting it to be easily tilted for opaque object projection and held rigidly in position by strong spring arm; conforms to the most rigorous requirements of **Boards of Underwriters**.

Illuminant—Hand-feed arc lamp for direct or alternating current, connected by two feed wires to a switch attached to rear of base; provided with magnetic coils to minimize "blowing."

Condensing System—Our regular triple system, with the two rear lenses of 6 and 8-in. diam. mounted directly in front of the lamp house in our special ventilated mount, giving a parallel beam of light in the dark chamber, and the front lens of $4\frac{1}{2}$ -in. diam. placed in front of the dark chamber immediately behind the slide carrier.

Dark Chamber—Of metal, light-tight, measuring $17 \times 11 \times 8\frac{1}{2}$ in.; with opening in bottom for projected objects, $8 \times 10\frac{1}{2}$ in., and metal diaphragms to give 8, 6 or 4-in. square opening, as desired; provided with two hinged doors giving opening large as entire side of dark chamber; one door has observation window; contains small condensing lens in swinging mount for use in high power microscopical and polariscopical projection.

Object Holder—Heavy metal plate, $11\frac{1}{2} \times 8\frac{1}{2}$ in., mounted on double arm with spring hinge at each end and handle at holder end; the whole adjustable for height by quick acting cam actuated by a lever; will accommodate objects of widely varying thicknesses and sizes, the holder always remaining parallel to base and automatically bringing objects into proper plane for projection; metal shield at front of base prevents light from flooding screen when object is being changed, while sliding velvet curtains on either side screen light when large objects are in place.

Slide Carrier—Our double, quick changing slide carrier, No. 4449, which gives a semi-dissolving effect and is so arranged that the slides can all be inserted from one side.

Bausch & Lomb Optical Company

Post Card Carrier—Two adjustable carriers with wooden frames which slide in holder fitting securely over opening in bottom of dark chamber.

Bellows—Mounted on metal frames which slide in metal ways.

Projection Lenses—Two of our new Balo lenses—one for lantern slides, with rack and pinion focusing adjustment, and one for the projection of opaque objects, with both rack and pinion and spiral focusing adjustments; the latter lens provided with large, first surface, adjustable reversing mirror. (See also Vertical Attachments.)

Dimensions—Length, back of lamp house to front end of bed, 66¾ in.; average height, 29½ in. to upper edge of reversing mirror.

| Code Word | Cat. No. | Specifications | Price |
|-----------------|---------------|---|-----------------|
| <i>Dunlin</i> | FRA15 | Convertible Balopticon, complete for projection of lantern slides and opaque objects, as described, with 15-in. focus, 4-in. diam. lens for opaque objects and 8-in. focus, 1½-in. diam. lens for lantern slides . . . | \$250.00 |
| <i>Dunt</i> | FRA18 | FRA 15, but with 18-in. focus, 4-in. diam. lens for opaque objects and 10-in. focus, 1½-in. diam. lens for lantern slides . . . | 250.00 |
| <i>Duncery</i> | FRA15a | FRA 15, but with special 15-in. focus, 4¼-in. diam. lens for opaque objects and 8-in. focus, 1½-in. diam. lens for lantern slides (see page 72) . . . | 300.00 |
| <i>Duncish</i> | FRA25 | FRA 15, but with special 25-in. focus, 5-in. diam. lens for opaque objects and 10-in. focus, 1½-in. diam. lens for lantern slides (see page 72) . . . | 325.00 |
| <i>Demijohn</i> | 4439 | Set of Accessories for projection of 4 x 5 or 5 x 7 transparencies, consisting of special slide carrier support, double slide carrier, 8-in. diam., 15-in. focus plano-convex condensing lens, tapering bellows and front standard, without projection lens . . . | 30.00 |
| <i>Demilune</i> | 4440 | Set of Mirrors for projecting specimens in vertical museum jars . . . | 15.00 |

Microscope Attachments

| Code Word | Cat. No. | Specification | Price |
|------------------|-------------|--|-----------------|
| <i>Duper</i> | 4138 | Large Projection Microscope, Horizontal Type, as illustrated (see page 73), including projection eyepiece (3X), substage water cell, three substage condensers and triple revolving nosepiece; mounted on swinging arm, without projection lens or objectives . . . | \$100.00 |
| <i>Duncheon</i> | 4139 | No. 4138, but with 32, 16 and 8 mm objectives . . . | 117.00 |
| <i>Dunter</i> | 4140 | No. 4139, but with large revolving plate to accommodate six objectives . . . | 129.00 |
| <i>Dunstable</i> | 4144 | Large Projection Microscope, Combined Horizontal and Vertical Type, as illustrated (see page 74), with projection eyepiece (3X), substage water cell, three substage condensers, revolving plate and nosepiece for six objectives (no objectives), reversing mirror for low power objectives and a prism for use over eyepiece . . . | 160.00 |
| <i>Dunstical</i> | 4145 | No. 4144, but with 32, 16 and 8 mm objectives . . . | 177.00 |
| <i>Dunted</i> | 4146 | No. 4144, but with 72, 48 and 32 mm Micro-Tessar, and 16, 8 and 4 mm achromatic objectives . . . | 265.00 |

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Vertical Attachments

| Code Word | Cat. No. | Specifications | Price |
|--------------|--------------|---|----------------|
| <i>Ditty</i> | 4136C | Vertical Attachment , consisting of dark chamber with two supports, adjustable interior mirror and sliding plate carrying $4\frac{1}{32}$ -in. diam. condenser in mount, 10-in. focus, $1\frac{1}{8}$ -in. diam. projection lens with reversing mirror on vertical rod, permitting latter to be moved out of path of light from projection lens for opaque objects. Accessories for projection of polarized light can be readily added . . . | \$47.50 |
| <i>Dirl</i> | 4142 | Special Vertical Attachment with dark chamber having interior adjustable mirror, 8-in. diam. condenser, 15-in. focus, $2\frac{5}{16}$ -in. diam. projection lens on vertical support with swinging arm so lens can be swung out of path of light from projection lens for opaque objects . . . | 50.00 |

Combined Vertical and Polariscope Attachment

| Code Word | Cat. No. | Specifications | Price |
|-----------------|--------------|---|-----------------|
| <i>Darkling</i> | 5525 | Combined Vertical and Polariscope Attachment consisting of dark chamber with adjustable interior mirror; sliding plate on top of chamber carrying rotating one-quarter wave mica plates, condensing lens, and projection lens with reversing mirror on vertical rod; optical bed carrying revolving stage with converging and diverging lenses and body tube with 4-in. focus objective and nicol prism analyzer in revolving mount; supports for revolving stage and body tube hinged for swinging out of path of light from projection lens for opaque objects; attaches to Convertible Balopticon in compact manner . . . | \$175.00 |
| <i>Dartrous</i> | 5525P | Polariscope Attachment only . . . | 160.00 |

Apparatus for Projection of the Spectrum and Complementary Colors

| Code Word | Cat. No. | Specifications | Price |
|-----------------|-------------|---|----------------|
| <i>Daffodil</i> | 4154 | Set of Accessories for projection of the spectrum and complementary colors , consisting of supplementary optical bed, adjustable slit and standard, carbon bisulphide prism, lenses, etc. . . | \$45.00 |
| <i>Daffish</i> | 4156 | Pair of Special Carbon Holders with revolving plates carrying special electrodes for holding chemical salts . . . | 15.00 |

Motion Picture Mechanisms

| Code Word | Cat. No. | Specifications | Price |
|------------------|-------------|--|-----------------|
| <i>Dytane</i> | 4700 | Powers No. 6a Mechanism complete with 12-in. upper and lower film magazines with take-up device, automatic fire shutter and lens . . . | \$188.00 |
| <i>Dyte</i> | 4705 | Edison Type D Mechanism complete with upper and lower film magazines for 12-in. reels and with take-up device, automatic fire shutter and lens . . . | 172.00 |
| <i>Dysphagic</i> | 4707 | Simplex Mechanism complete with 16-in. upper and lower film magazines, take-up device and 14-in. reels, automatic fire shutter and lens, and film rewinder . . . | 238.00 |
| <i>Dyvoor</i> | 4710 | Special Stand designed for mounting motion picture mechanism in connection with Convertible Balopticon and giving interchange between motion picture and other forms of projection (see page 79). . . | 75.00 |

Simplified Micro-Projection Apparatus

There is a steadily growing tendency on the part of biology teachers to illustrate their work as much as possible, using for this purpose the regular microscope slides. In many cases an elaborate equipment is not required, and in others the larger, more elaborate outfits cannot be purchased for lack of funds.

To meet this situation we are offering a simple apparatus for micro-projection, consisting of an illuminant with equipment for use in connection with a projection microscope or the regular laboratory microscope. Our apparatus for projection of the **spectrum and complementary colors** can also be used with this outfit.

Upon a baseboard, 10 x 36 inches, is secured one of our regular optical beds, 22 inches long, which carries the microscope or any required accessories. At one end of the baseboard is mounted a miniature, 4½-ampere arc lamp. The support of this lamp is adjustable for height by raising or lowering the post in its socket and is also provided with fine adjustment screws for horizontal as well as vertical adjustment. The lamp, which is of the 90-degree type, takes the pencil size carbons with one carbon (the positive in case of direct current) coincident with the optical axis. The carbons may be adjusted separately or together, by a single button. A 4½-ampere, 110-volt rheostat with 15 feet of lamp cord and connecting plug is regularly included. (A rheostat for 220 volts can be supplied at additional cost.)

The spherical correction of the condensing lenses used in connection with the illuminant is one of the principal points to be considered in microscopical projection. We would for this reason call particular attention to the fact that we have designed an **aspheric condenser** of 60 mm (2¾ inches) diameter, which is **corrected for spherical aberration by grinding to non-spherical curves**. This condenser is a part of the regular equipment on the outfit.

By means of this correction an image of the arc is formed practically in one plane, so that a much greater percentage of the light collected from the arc may be utilized by the substage condenser than is possible with the regular spherical condensers. The focus of this aspheric lens is such that it takes in a cone of light from the arc lamp of about 60° and forms a large image of the arc, so that the full aperture of the substage condenser can be utilized.

An adjustable mounting is attached to the front of the lamp housing for the condensing lens, and it should be so adjusted with relation to the arc that the arc image is formed at the diaphragm plane of the substage condenser. With this lens and the 4½-ampere arc lamp it is possible to project microscopic specimens with approximately the same brilliancy that can be secured when using a much higher amperage in connection with a combination apparatus. The main problem in microscopical projection is to secure an arc image sufficiently large to fill the effective aperture of the substage condenser being used.

We recommend the use of our **Large Projection Microscope**, as illustrated in Figure 1, which is equipped with a series of substage condensers so computed that maximum illumination and field are secured with all objectives, from the 72 mm Micro-Tessar to the 1.9 mm oil immersion. See "Accessories."



Figure 1—Simplified Micro-Projection Apparatus, Showing Large Projection Microscope Mounted on Optical Bed.

If it is desired to project objects which must be maintained in a horizontal position on the stage, our **Combined Horizontal and Vertical** type of projection microscope is recommended.

While the projection microscope should be used for the best results with objectives of widely varying powers, highly satisfactory results will be obtained with the **regular compound microscope**, especially when using the medium power objectives such as the 16, 8 and 4 mm. To accommodate the regular microscope a plate can be supplied which attaches to the optical bed and is provided with a clamp for holding the microscope.



Figure 2—Simplified Illuminating Apparatus, Showing Accessories for Projection of Spectrum and Complementary Colors, Mounted on Optical Bed.

The arc lamp has sufficient latitude of adjustment to permit the microscope to be used in the vertical position when working with fluid preparations. In this position it is, of course, necessary to place a reflecting prism or mirror over the eyepiece to direct the light toward the screen.

A suitable diaphragm is included with each outfit to prevent the extraneous light from reaching the screen. In the case of the outfits using a laboratory microscope this diaphragm is placed back of the microscope, as illustrated in Figure 3.

The regular Abbe condenser works very well with the higher power objectives, but for the 16 mm and lower powers the upper portion of this condenser should be removed in order to obtain a properly lighted field.

This simple apparatus also furnishes an excellent illuminant for the set of accessories used in the projection of the spectrum, absorption spectra and complementary colors, since it projects upon the slit an exceptionally well defined image of the arc. See "Accessories." This outfit is illustrated in Figure 2.

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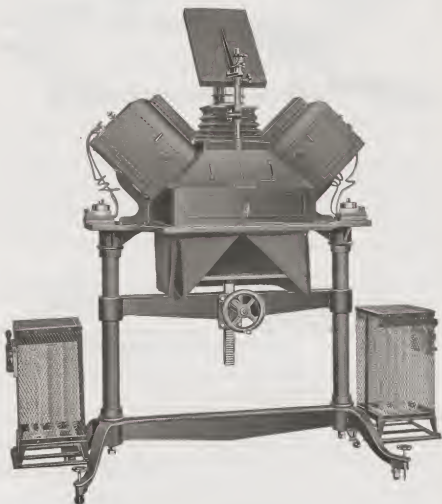
The apparatus also furnishes an excellent light source for photomicrography, and any laboratory having occasion to use a simple illuminating apparatus will find numerous uses for it.



Figure 3—Simplified Micro-Projection Apparatus without Optical Bed, Showing Regular Table Microscope Clamped to Baseboard.

In order to provide as inexpensive an outfit as possible we are prepared to supply this apparatus with a bi-convex condenser of spherical curvature in place of the aspheric condenser and also without the optical bed. (See Figure 3.) This condenser does not, of course, give the clear, brilliant field obtained with the aspheric, but its efficiency is of a comparatively high order. When the optical bed is omitted, a simple clamp is provided at the end of the baseboard to hold the microscope.

| Code Word | Cat. No. | Specifications | Price |
|------------------|-------------|--|-----------------|
| <i>Dytiscus</i> | 4300 | Simplified Illuminating Apparatus for Micro-Projection, consisting of baseboard, optical bed, arc lamp, rheostat and aspheric condenser in adjustable mount | \$ 43.00 |
| <i>Dystocia</i> | 4302 | Same as above, but with bi-convex condenser in place of aspheric, without optical bed and with clamp to hold microscope | 30.00 |
| <i>Dystrophy</i> | 4304 | Microscope Plate fitting optical bed of No. 4300 to hold regular compound microscope | 3.50 |
| <i>Dysuria</i> | 4306 | Aspheric Condenser , 60 mm (2 $\frac{3}{8}$ in.) diam., in mounting. (Specify outfit on which it is to be used.) | 10.00 |
| <i>Duper</i> | 4138 | Large Projection Microscope, Horizontal Type (see "Accessories"), including projection eyepiece (3 \times), substage water cell, three substage condensers and triple revolving nosepiece; mounted on swinging arm, without projection lens or objective | 100.00 |
| <i>Dungeon</i> | 4139 | No. 4138, but with 32, 16 and 8 mm objectives | 117.00 |
| <i>Dunter</i> | 4140 | No. 4139, but with large revolving plate to accommodate six objectives | 129.00 |
| <i>Dunstable</i> | 4144 | Large Projection Microscope, Combined Horizontal and Vertical Type (see "Accessories"), with projection eyepiece (3 \times), substage water cell, three substage condensers, revolving plate and nosepiece for six objectives (no objectives), reversing mirror for low power objectives and a prism for use over eyepiece | 160.00 |
| <i>Dunstical</i> | 4145 | No. 4144, but with 32, 16 and 8 mm objectives | 177.00 |
| <i>Dunted</i> | 4146 | No. 4144, but with 72, 48 and 32 mm Micro-Tessar, and 16, 8 and 4 mm achromatic objectives | 265.00 |



(About $\frac{1}{20}$ Natural Size)

Balopticon for Large Opaque Objects
Rear View, Showing Adjustments

Balopticon for Large Opaque Objects

Designed for the direct projection of opaque objects and illustrative material on a much larger scale than ever before attempted, this unique Balopticon has proved entirely practical in operation and presents many new possibilities. Projecting, as it does, opaque objects measuring **20 inches square**, the instrument affords excellent opportunities for projecting on the screen large anatomical specimens, charts, etc.

Not only is this Balopticon of service to the medical school, but in the Departments of Science, Engineering, etc., it is a valuable aid in projecting experiments, blue prints, working models or mechanical parts, etc. All subjects are clearly shown in their natural form and coloring in greatly enlarged images, which permit fine distinctions and details to be seen by a large audience.

Model LR was originally designed for the National Cash Register Company, which is using four of these instruments in educating its salesmen. A section of a cash register is placed in the Balopticon and shown on the screen in actual operation, while large advertisements and placards are also projected for purposes of comparison and discussion.

The 400 square inches of projected area are brilliantly illuminated to the edges by two arc lamps carried in large, light-tight lamp houses. A 6-inch condensing lens is carried before each lamp in a sliding mount operated from without, so that a smaller, more brilliant area can be projected by sliding these condensers into position. The illuminants are, however, sufficiently powerful to obviate the need for condensers with ordinary subjects, yet are not so close as to heat the specimen unduly. Their position also results in complete elimination of all shadows.

The projection lens is a high grade photographic, anastigmat lens, a **Bausch & Lomb Tessar Ic** of 19 $\frac{3}{4}$ -inch focus and 4 $\frac{7}{16}$ -inch diameter, which has **unusual covering power** for its speed—F:4.5. A mirror of a very high grade, measuring 17 $\frac{1}{2}$ x 9 $\frac{1}{2}$ inches and silvered on the first surface, directs the light toward the screen and also causes objects, illustrations and printed matter to appear in their true position.

Focusing is accomplished by bringing the object into range of the lens. The large object table is adjustable vertically by means of a heavily constructed worm wheel and pinion actuating a rack. Objects of any thickness up to 9 inches can be accommodated, a dark velvet curtain preventing the light from escaping when the carrier is lowered.

This unique instrument is naturally one of unusually large proportions for a projection lantern. The massive iron base has a spread of 54 x 24 inches, being provided with both castors and leveling screws. The height of the stand to the top of the mirror is approximately 80 inches.

| Code Word | Cat. No. | Specifications | Price |
|------------------|--------------|---|-----------------|
| <i>Desconfit</i> | LR 20 | Model LR Balopticon , complete as described and illustrated, but without rheostats | \$665.00 |



Special Dissolving Equipment

Special Dissolving Equipment For 5x7-Inch Plates

This double dissolving equipment is of the very highest order, offering the widest and most convenient range of adjustments possible. It is designed primarily for the projection of **5x7 autochrome plates**. The lanterns are mounted on optical beds of the lathe type, which will accommodate projection lenses up to **42 inches** equivalent focus. The lamp houses and standards are adjustable along these beds and are clamped in position by strong clamps.

All instruments of this type have thus far been made of aluminum throughout, being used as traveling outfits, and the use of this metal, of course, greatly increases the cost of the apparatus. This Special Dissolving Equipment is made to order only.

Specifications

Base—Consists of two supports of 26-in. lateral spread with pillars carrying the lower optical bed, and with arms supporting the upper bed, 9 in. above and 15 in. to the left of the first; front pillar adjustable for height by long range screw operated by wheel, 10 in. in diam., and with clamping lever for rigidity, permits adjustment for use on floor or in gallery of auditorium; special braces at front and rear give proper rigidity; feet provided with castors and leveling screws.

Optical Beds—Length, 59 in., accommodating lenses up to 42 in. E. F.; accurately milled and of large cross section; provided with accurate adjustment for securing coincidence of pictures on screen; height of lower bed from floor, 44 in.

Lamp Houses—Measure 13½ in. long, 15 in. high and 8 in. wide; light-tight and freely ventilated; constructed of double sheet metal walls with an air space between the two walls and the roofs fitted with our special patented ventilator; provided with large, light-tight, spring doors on side and observation windows on both sides; **conform to most rigorous requirements of Boards of Underwriters.**

Illuminants—Hand-feed arc lamps for direct or alternating current, connected by two feed wires to a switch attached to rear of base and provided with magnetic coils to minimize "blowing"; or 1000-watt, gas-filled, Mazda stereopticon lamps.

Condensing Systems—Our triple systems in patent, ventilated mount with lenses 8 in. in diam.

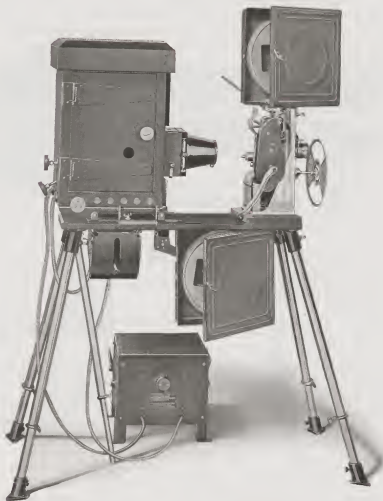
Slide Carriers—Two sets of carriers for 5x7-in. plates, one taking the slide the long way vertically, the other the long way horizontally; carriers for special sizes made to order.

Bellows—Mounted on metal frames which slide in metal ways; provided with supports to prevent sagging.

Projection Lenses—Our Balo series lenses of 40-in. focus, 4-in. diam., in rack and pinion focusing mounts; other focal lengths can be supplied.

Iris Dissolver—Our patented iris dissolver with 4-in. diaphragm openings.

Prices quoted on request.



Edison Kinetoscope, Model D

Edison Kinetoscope Model D

Mechanism—Intermittent movement of massive construction; all parts subjected to severe wear are of unusual size, made of tempered tool steel and provided with hardened steel bearings; driving gears protected by pressed-steel guard; three sprockets are of polished steel, supplied with tension rollers of polished, case-hardened steel, giving tension where required and preventing drag on the film; only the film margins come in contact with the machine; chain take-up attachment provides even tension; positive system of oiling through a series of tubes.

Fire Shutter—Positive in action; automatically closes when speed of mechanism falls below a fixed point.

Magazines—Of Russia iron; contain reels up to 12 in. in diam.; double aluminum rollers, between which the film passes, reduce wear and prevent any flame from entering the magazines.

Objectives—Bausch & Lomb motion picture projection lens of highest grade; Bausch & Lomb Balo projection lens for stereopticon attachment. When ordering, be sure to state projection distance and size of picture desired.

Lamp House—Of new design, large and well-ventilated; has square condenser holders and patented back which permits the arc lamp adjusting buttons to be moved to any position; condensers mounted in flat metal carriers and secured in position by tension springs; lamp house provided with liberal lengthwise and lateral adjustments; accommodates 12-in. upper and 6-in. lower carbons; provided with observation window and has no open slots.

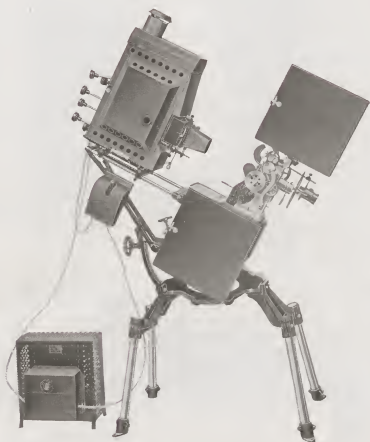
Arc Lamp—Rack and pinion type for use on direct or alternating current; provided with all necessary adjustments; accommodates $\frac{1}{4}$ to $\frac{3}{4}$ -in. diam. carbons.

Rheostat and Switch—Grid type rheostat for direct or alternating current; rheostat switch contacts and binding posts are inside the sheet metal frame; large switch is double pole, knife type of ample capacity, mounted on slate base; heavy Russia iron cover with fiber bushings where connecting cords enter; by mounting on a second cast-iron base which slides under Model D baseboard, the connecting cords between lamp and rheostat are permitted to remain permanently attached to the switch.

Stand—Metal baseboard with flanges and five adjustable, nickel-plated legs, the four outside having floor sockets with set-screws.

Complete catalog on request.

| Code Word | Cat. No. | Specifications | Price |
|---------------|-------------|---|-----------------|
| <i>Dam</i> | 4800 | Edison Kinetoscope, Model D, as described and illustrated, with 110-volt, 25-40 ampere rheostat | \$250.00 |
| <i>Damage</i> | 4802 | Same, but with 220-volt, 25-40 ampere rheostat | 275.00 |
| <i>Damon</i> | 4804 | Same, but with 110-volt, 60-cycle Economy Transformer | 270.00 |
| <i>Damar</i> | 4806 | Same, but with 220-volt, 60-cycle Economy Transformer | 275.00 |



Powers' Cameragraph No. 6 B

Powers' Cameragraph No. 6B

- Mechanism**—Intermittent movement of original design and large size; gives long period of rest and easy, rapid transition; frame is heavy and rigid; gears of large diameter and wide face with spirally cut teeth; larger gears are of anti-friction phosphor bronze; all parts perfectly interchangeable; picture is framed without altering relation between aperture, projection lens and revolving shutter; three sprockets of case-hardened steel, specially selected; rollers hold film on sprocket without pressing on film; special attachment automatically resets lower loop.
- Fire Shutter**—Simple in construction; positive in operation; supplied with upper and lower film shields which protect film practically throughout its course from upper to lower magazine.
- Magazines**—Fire-proof, 14 in. square; heavy gauge, Russia iron boxes equipped with patented film valves through which no flame can pass; patent take-up device maintains same tension regardless of quantity of film on reel; take-up has chain drive, belt drive optional.
- Objectives**—Bausch & Lomb motion picture projection lens of highest grade; Bausch & Lomb Balo projection lens for stereopticon attachment. When ordering, be sure to state projection distance and size of picture desired.
- Lamp House**—Of extra heavy Russia iron; large and well ventilated, with hinged cover to direct hot air away from operator; back practically all enclosed and adjusting rods of arc lamp have universal joints to permit their passing through smallest possible openings; complete with condensers, sliding ways, slide carrier, etc.
- Arc Lamp**—Rack and pinion type; provided with every possible adjustment, all reached from outside the lamp house; accommodates $\frac{3}{8}$ to $\frac{3}{4}$ -in. diam. carbons, the upper 12 in. long, the lower 6 in.
- Rheostat and Switch**—Grid type, well ventilated, for direct or alternating current; switch of double pole, single throw type and 60 amperes capacity; provided with heavy slate base, heavy Russia iron cover and bushings for protection of wires.
- Stand**—Cast iron stand, properly braced and with adjustable, nickel-plated legs and set of four floor sockets.

Complete catalog on request.

| Code Word | Cat. No. | Specifications | Price |
|------------------|-------------|--|-----------------|
| <i>Damascene</i> | 4808 | Powers' Cameragraph No. 6B , as described and illustrated, complete with 110-volt, 45-ampere, adjustable rheostat | \$290.00 |
| <i>Damascus</i> | 4810 | Same, but with 110-volt, direct or alternating, 60-cycle motor attachment | 337.50 |
| <i>Damaskeen</i> | 4812 | 220-volt Rheostat , 25-45 amperes extra | 12.00 |
| <i>Damaskin</i> | 4814 | 220-volt , direct or alternating, 60-cycle motor extra | 5.00 |
| <i>Damasse</i> | 4816 | Powers' Inductor for 110 or 220 volts, 60 cycles, alternating current, instead of rheostat | 50.00 |



Simplex Moving Picture Equipment

Simplex Regular Equipment

Mechanism—Enclosed, fire and dust-proof, with hinged doors and large observation window; intermittent movement of Geneva type, consisting of star and cam operating in box filled with oil; movement perfectly balanced; practically all gears are cut from cast iron, tool steel and phosphor bronze; least number of gears employed and these are placed in center line position; only two operations required in threading; lens holders always absolutely parallel to aperture plate; take-up of simple, rigid design driven by belt or chain from main driving gear.

Fire Shutter—Controlled by centrifugal governor; operates without springs or rollers.

Magazines—New standard, drawn in two pieces from No. 18 gauge steel; 16 in. inside diam.; accommodate 2000 ft. reels; equipped with improved, malleable iron strap hinges, 7½ in. wide; self-closing doors with spring latch and 3 x 4 x ¼-in. wire glass window in upper magazine.

Objectives—Bausch & Lomb motion picture projection lens of highest grade; Bausch & Lomb Balo projection lens for stereopticon attachment. When ordering, be sure to state projection distance and size of picture required.

Lamp House—Of best Russia iron; ample in size to permit perfect ventilation and heat radiation; metallic screens shield ventilating holes at top and bottom; condenser mount permits expansion and contraction without danger of breakage; lamp can be withdrawn from back of lamp house, making all parts readily accessible; accommodates 12-in. upper and 6-in. lower carbons; complete with sliding ways, slide carrier, etc.

Arc Lamp—Has eight adjustments—six operated from back of lamp house; remaining two, for altering angle of carbon, are operated from inside.

Rheostat and Switch—Enclosed 110-volt rheostat, grid type, adjustable 25-45 amperes; 60-ampere, double pole, knife switch enclosed in steel box.

Stand—Heavy cast iron, adjustable pedestal, complete with lag screws; furnished in two heights—39 in. or 47½ in. from floor to center of lens.

Complete catalog on request.

| Code Word | Cat. No. | Specifications | Price |
|------------------|-------------|---|-----------------|
| <i>Damassin</i> | 4820 | Simplex Regular Equipment , complete as described and illustrated, with 110-volt, 25-45 ampere rheostat and Simplex rewinder | \$300.00 |
| <i>Dambonite</i> | 4822 | Model B-1, as above, but with complete motor drive for 50, 110 or 220 volts, direct or alternating current, 25 to 60 cycles | 355.00 |
| <i>Dame</i> | 4824 | 220-volt , 25-45 ampere, grid rheostat extra | 20.00 |

Suggested Outfits

A few complete outfits for different kinds of projection are outlined below. It should be borne in mind that these are only general suggestions and the selection of a particular outfit should be made to suit conditions depending on distance from screen to lantern, size of picture desired, etc. The focus of lens and size of screen should be selected accordingly.

For Lantern Slide Projection

Where electricity is not available.

Outfit No. 1

| | | | | | | | | |
|--|---|---|---|---|---|---|---|-----------|
| 1 No. CG10 Model C Balopticon | - | - | - | - | - | - | - | \$38.00 |
| 1 No. 4447 30 cubic-ft. Acetylene Tank | - | - | - | - | - | - | - | net 15.00 |
| 1 No. 4421 Screen, 7 x 7 feet | - | - | - | - | - | - | - | net 6.00 |
| 1 No. 4252 Stand | - | - | - | - | - | - | - | 16.00 |

Where electricity is available only from an ordinary lighting socket.

Outfit No. 2

| | | | | | | | | |
|-------------------------------|---|---|---|---|---|---|---|----------|
| 1 No. CM10 Model C Balopticon | - | - | - | - | - | - | - | \$42.00 |
| 1 No. 4422 Screen, 8 x 8 feet | - | - | - | - | - | - | - | net 7.20 |
| 1 No. 4252 Stand | - | - | - | - | - | - | - | 16.00 |

In auditoriums where alternating current only is available.

Outfit No. 3

| | | | | | | | | |
|---------------------------------|---|---|---|---|---|---|---|-----------|
| 1 No. CML15 Model C Balopticon | - | - | - | - | - | - | - | \$57.00 |
| 1 No. 4425 Screen, 10 x 10 feet | - | - | - | - | - | - | - | net 15.00 |
| 1 No. 4252 Stand | - | - | - | - | - | - | - | 16.00 |

With arc lamp where 15 amperes of current are available.

Outfit No. 4

| | | | | | | | | |
|---------------------------------|---|---|---|---|---|---|---|-----------|
| 1 No. CA15 Model C Balopticon | - | - | - | - | - | - | - | \$40.00 |
| 1 No. 4450 Rheostat | - | - | - | - | - | - | - | 7.00 |
| 1 No. 4425 Screen, 10 x 10 feet | - | - | - | - | - | - | - | net 15.00 |
| 1 No. 4252 Stand | - | - | - | - | - | - | - | 16.00 |

For traveling lecturer's use, where the most compact equipment is desired, and also one that may be used with either acetylene gas or electricity.

Outfit No. 5

| | | | | | | | | |
|--|---|---|---|---|---|---|---|----------|
| 1 No. CGMP10 Special Portable Model C Balopticon | - | - | - | - | - | - | - | \$56.00 |
| 1 No. 4420S Sateen Screen, 6 x 6 feet | - | - | - | - | - | - | - | net 3.50 |

Outfit No. 6

| | | | | | | | | |
|--|---|---|---|---|---|---|---|----------|
| 1 No. BMGP10 Special Portable Model B Balopticon | - | - | - | - | - | - | - | \$48.00 |
| 1 No. 4420S Sateen Screen, 6 x 6 feet | - | - | - | - | - | - | - | net 3.50 |

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With dissolving views.

Outfit No. 7

| | | | | | | | |
|-----------------------------------|---|---|---|---|---|---|-----------|
| 1 Double CML15 Model C Balopticon | - | - | - | - | - | - | \$130.00 |
| 1 No. 4425 Screen, 10 x 10 feet | - | - | - | - | - | - | net 15.00 |
| 1 No. 4252 Stand | - | - | - | - | - | - | 16.00 |

Outfit No. 8

| | | | | | | | |
|-----------------------------------|---|---|---|---|---|---|-----------|
| 1 Double DAL15 Model D Balopticon | - | - | - | - | - | - | \$170.00 |
| 2 No. 4450 Rheostats | - | - | - | - | - | - | 14.00 |
| 1 No. 4425 Screen, 10 x 10 feet | - | - | - | - | - | - | net 15.00 |
| 1 No. 4252 Stand | - | - | - | - | - | - | 16.00 |

With dissolving lantern slide views and moving picture
projection, interchangeably.

Outfit No. 9

| | | | | | | | |
|---|---|---|---|---|---|---|-----------|
| 1 No. 5212, 5214 or 5216, depending on mechanism desired (see p. 37 for price) | | | | | | | |
| 1 No. 4454 Rheostat | - | - | - | - | - | - | \$18.00 |
| 1 No. 4456 Rheostat | - | - | - | - | - | - | 27.00 |
| 1 No. 4425 Screen, 10 x 10 feet | - | - | - | - | - | - | net 15.00 |

For use in Physical Science Departments where an apparatus with
optical bed, to which various attachments may be
added, is desired.

Outfit No. 10

| | | | | | | | |
|--------------------------------|---|---|---|---|---|---|-----------|
| 1 No. DA10q Model D Balopticon | - | - | - | - | - | - | \$65.00 |
| 1 No. 4450 Rheostat | - | - | - | - | - | - | 7.00 |
| 1 No. 4423 Screen, 9 x 9 feet | - | - | - | - | - | - | net 12.00 |
| 1 No. 4252 Stand | - | - | - | - | - | - | 16.00 |

For Microscopical Projection Only

Particularly recommended where only alternating current is available.

Outfit No. 11

| | | | | | | | |
|---|---|---|---|---|---|---|---------|
| 1 No. 4300 Simplified Micro-Projection Outfit | - | - | - | - | - | - | \$43.00 |
| 1 No. 4304 Microscope Plate | - | - | - | - | - | - | 3.50 |

With this equipment either the regular table microscopes or the special
projection microscopes (see pp. 109-112) may be used.

Balopticon
Accessories

Balo Projection Lenses



The recent development of apparatus for projecting opaque areas of large size and the adaptation of the Mazda lamp to this work, as well as to lantern slide projection, have placed new and heavy demands upon the projection lenses used. For projecting opaque objects a lens of very large diameter is required to collect in sufficient quantity the rays reflected from the lighted surface of the object. In lantern slide projection a lens larger than that used with the arc is required to utilize the entire image of the light source as pro-

jected upon the lens aperture by the condensers. Other things being equal, the illumination depends on the diameter of the lens, the efficiency of two different lenses comparing inversely as the square of their respective diameters.

To meet this situation our Scientific Bureau has computed the new series of **Balo projection lenses**. Balo lenses are corrected for chromatic and spherical aberration and give critical definition to the extreme edges of the field. Since an increase in the diameter of the lens greatly increases the difficulty of correcting for these aberrations, it may be seen that the new series represents a real achievement in the production of high grade lenses for optical projection. With two exceptions these lenses are used on all Balopticons.

The lenses of $1\frac{3}{8}$ and $2\frac{5}{16}$ inches diameter are intended particularly for lantern slide projection. The former is made in focal lengths up to 10 inches and its use should be confined to outfits equipped with arc lamp. For longer focal lengths and especially for use with a comparatively large light source, such as the Mazda lamp or acetylene burner, the $2\frac{5}{16}$ -inch diameter should be chosen. With such light sources this lens gives an approximate increase in illumination of 40 per cent. over the $1\frac{3}{8}$ -inch diameter lens.

The larger diameters are especially constructed for the projection of opaque objects. They have a ratio between diameter and focal length which varies between 1:3.5 and 1:5. The 4-inch diameter lenses have a special adjustment to accommodate them to varying projection distances, especially when working close to the screen.

These lenses are very accurately mounted in heavy brass tubes with rack and pinion focusing adjustment and are finished in black with white engraving.

| Code Word | Cat. No. | Diameter in Inches | Focus in Inches | Price |
|------------------|----------|--------------------|-----------------|----------|
| <i>Dab</i> | 4006 | $1\frac{3}{8}$ | 6 | \$ 10.50 |
| <i>Dabble</i> | 4008 | $1\frac{3}{8}$ | 8 | 10.50 |
| <i>Dabbler</i> | 4010 | $1\frac{3}{8}$ | 10 | 10.50 |
| <i>Dace</i> | 4020 | $2\frac{5}{16}$ | 10 | 18.00 |
| <i>Dachshund</i> | 4022 | $2\frac{5}{16}$ | 12 | 18.00 |
| <i>Dacian</i> | 4025 | $2\frac{5}{16}$ | 15 | 18.00 |
| <i>Dacoty</i> | 4028 | $2\frac{5}{16}$ | 18 | 18.00 |
| <i>Dactyl</i> | 4045 | 4 | 15 | 50.00 |
| <i>Dactylar</i> | 4048 | 4 | 18 | 50.00 |
| <i>Dactylic</i> | 4045a | $4\frac{1}{4}$ | 15 | 100.00 |
| <i>Dactyli</i> | 4055 | 5 | 25 | 125.00 |

Condensing Lenses

Because of the quality of glass used and the superior workmanship our condensing lenses are considered standard. They are carefully annealed and finished. Although our patent, ventilated mount (see page 19) minimizes the danger of breakage, yet with all possible care condensers are still liable to break and it is well to have an extra set at hand.

| Code Word | Cat. No. | Specifications | Price |
|-----------------|-------------|---|----------------|
| <i>Dabster</i> | 5095 | Plano-Convex lens, 4-in. diam., rear lens of the regular Model C system, unmounted | \$ 1.25 |
| <i>Dare</i> | 5096 | Plano-Convex lens, $4\frac{5}{16}$ -in. diam.; front lens of the regular Models B and C systems. Be sure to state focus of projection lens when ordering | 1.50 |
| <i>Dandler</i> | 5102 | Plano-Convex lens, $4\frac{5}{16}$ -in. diam.; rear lens of Home and CRM systems, unmounted | 1.50 |
| <i>Dandriff</i> | 5104 | Plano-Convex lens, $4\frac{5}{16}$ -in. diam.; front lens of Home and CRM systems. Be sure to state focus of projection lens when ordering | 1.50 |
| <i>Dandy</i> | 5106 | Plano-Convex lens, $4\frac{5}{16}$ -in. diam.; rear lens of model B system, unmounted | 1.50 |
| <i>Dasher</i> | 4411 | Plano-Convex lens, $4\frac{15}{32}$ -in. diam., 10-in. focus; middle lens of regular Model D and CRA systems and front lens of Model C system with attachment for opaque objects | 1.50 |
| <i>Dartoic</i> | 4415 | Plano-Convex lens, $4\frac{15}{32}$ -in. diam.; front lens of regular Model D, CRA, Universal and Convertible systems, unmounted. Be sure to state focus of projection lens when ordering | 1.50 |
| <i>Darrain</i> | 4427 | Plano-Convex lens, 6-in. diam., 10-in. focus; middle lens of Universal system, unmounted | 3.00 |
| <i>Daub</i> | 4413 | Meniscus Convex lens, 4-in. diam., $11\frac{1}{2}$ -in. focus; rear lens of Models D and CRA systems and of Model C with opaque object attachment | 2.50 |
| <i>Darr</i> | 4419 | Meniscus Convex lens, $5\frac{1}{2}$ -in. diam., $11\frac{1}{2}$ -in. focus; rear lens of Universal system, unmounted | 6.00 |
| <i>Dartre</i> | 4428 | Meniscus Convex lens, 6-in. diam., $11\frac{1}{4}$ -in. focus; rear lens of Convertible system, unmounted | 7.00 |
| <i>Dartle</i> | 4429 | Double Convex lens, $7\frac{3}{4}$ -in. diam., 11-in. focus; middle lens of Convertible system, unmounted | 10.00 |
| <i>Dariole</i> | 5097 | Special Condenser System , with 4-in. diam. Meniscus and $4\frac{15}{32}$ in. diam. Plano-Convex lenses in the Bausch & Lomb patent, ventilated mount; for use in place of the regular double system when using the opaque object attachment | 5.00 |

Aspheric Condenser for Micro-Projection

In microscopical projection the spherical correction of the condensing lenses used in connection with the illuminant is one of the principal points to be considered. We would for this reason call particular attention to the fact that we have designed for this work an **aspheric condenser** of 60 mm ($2\frac{3}{8}$ inches) diameter, which is **corrected for spherical aberration by grinding to non-spherical curves.**

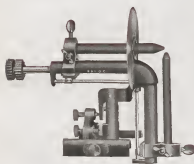
By means of this correction an image of the arc is formed practically in one plane, so that a much greater percentage of the light collected from the arc may be utilized by the substage condenser than is possible with the regular spherical condensers. The focus of this aspheric lens is such that it takes in a cone of light from the arc lamp of about 60° and forms a large image of the arc, so that the full aperture of the substage condenser can be utilized.

The results obtained with this condenser in all kinds of work with the microscope are so highly satisfactory that no doubt some of those who already have our Large Photomicrographic Camera or Combined Drawing and Photomicrographic Apparatus will wish to replace their condenser with this new form. We are therefore supplying it in mounts to fit these equipments as well. The aspheric condenser should not be used with an arc consuming more than five amperes of current.

| Code Word | Cat. No. | Specifications | Price |
|----------------|-------------|---|----------------|
| <i>Dysuria</i> | 4306 | Aspheric Condenser, 60 mm ($2\frac{3}{8}$ in.) diameter, in mounting. (Specify outfit on which it is to be used.) | \$10.00 |

Illuminants

Hand-feed Arc Lamp



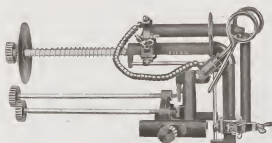
This lamp is carefully constructed, with screws and gears cut so as to prevent binding even after being thoroughly heated. The carbons can be fed independently or simultaneously. A wide range of adjustment is provided for by accurate centering screws, and all adjusting and feeding screws are carefully insulated.

Either direct or alternating current can be used, although the former is desirable as it gives greater illumination, is quieter in operation and more easily and accurately controlled.

A rheostat must always be used with this lamp to regulate the current.

| Code Word | Cat. No. | Specifications | Price |
|-----------------|-------------|---|----------------|
| <i>Desolate</i> | 4464 | Hand-feed Arc Lamp, with centering support | \$10.00 |

Hand-feed Arc Lamp with Magnetic Coils



This lamp is of the same type of construction as the one described before, but it has the extension feeding and centering rods necessary for use in the large lamp house. The carbon holders are of the yoke type, giving better contact for the high amperages. This type of carbon holder is

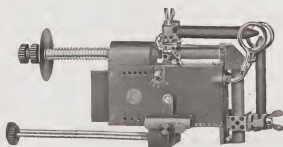
supplied on all arc lamps with the Combined, Universal and Convertible Balopticons. A feature of this lamp as illustrated is the magnetic coil which aids greatly in steadying the arc and preventing the "magnetic blow." This coil is supplied regularly on all lamps for the Convertible Balopticon.

A rheostat must always be used with this lamp to regulate the current.

| Code Word | Cat. No. | Specifications | Price |
|-------------------|--------------|--|----------------|
| <i>Desolately</i> | 4464C | Hand-feed Arc Lamp with extension feeding and adjusting rods, yoke type of carbon holders and magnetic coils | \$15.00 |

Note—The magnetic coil can be supplied on any arc lamp which is to be fitted in one of the large lamp houses at an additional cost of \$5.00.

Combined Automatic and Hand-feed Arc Lamp



An arc lamp with automatic feed is a great convenience when projecting with the microscope or other accessories which require very accurate arc adjustment. The carbon feed of this lamp is entirely magnetic and operates on the full line voltage so that the feed remains absolutely

constant. This is accomplished by a supplementary wire running from the intake side of the rheostat to the center binding post on the lamp. By means of an adjusting screw on the side of the lamp the separation and consequently the frequency of feeding of the carbons is adjusted to suit the exact voltage on which the lamp is operated. Be sure to state voltage when ordering, as the magnet must be wound accordingly.

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As an automatic lamp, this can only be used on direct current, but by disengaging the automatic mechanism it is readily transformed into the hand-feed type for use on either current.

A rheostat must always be used with this lamp to regulate the current.

| Code Word | Cat. No. | Specifications | Price |
|---------------|----------|---|---------|
| <i>Defail</i> | 4463 | Combined Automatic and Hand-feed Arc Lamp with adjustable support | \$75.00 |

Note—This lamp may be substituted for the hand-feed arc on any of our Balopticons when ordering, at an additional cost of \$65.00.

Gas-filled Mazda Lamps

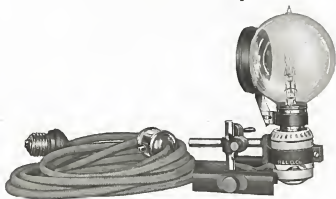


Figure 1—400-Watt Gas-Filled Mazda Lamp.

The new gas-filled Mazda lamps with concentrated filament, which have been especially developed for projection purposes, furnish an automatic, steady-burning and very efficient and economical light source for the simpler types of Balopticons. The efficiency varies from 0.8 watt per candle power in the lower wattages to 0.55 watt per candle power in the higher wattages. They are rated by the manufacturer to have a life of approximately 200 hours and we stand ready to replace any that may prove defective or burn for an unduly short period. If the Mazda burned only one-half its rated life, the cost of operating this type, including renewals, would be much less than the cost of an arc lamp giving equal illumination, when the saving in current and carbon consumption is considered. In addition, the Mazda is entirely automatic, noiseless and steady in operation and its efficiency per number of amperes used is higher than that of the A. C. arc. These lamps are not recommended for microscopical projection as they are not sufficiently concentrated or homogeneous. With the exception of the 1000-watt lamp, they may be attached to any regular lamp socket. They are used without resistance on circuits of 110-115 volts. For 220-volt circuits a resistance (listed on page 107) must be used in series with the lamp.

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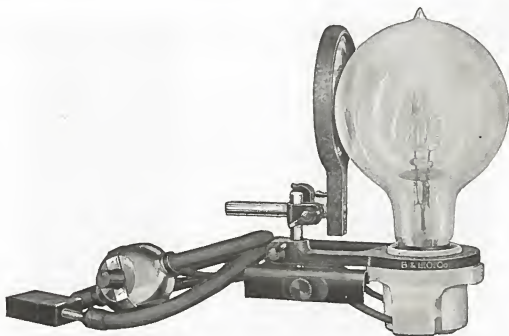


Figure 2—1000-Watt Gas-Filled Mazda Lamp.

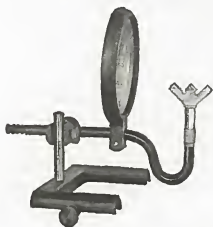
| Code Word | Cat. No. | Specifications | Price |
|-------------------|-------------|---|--------------------------|
| <i>Despot</i> | 4465 | 250-watt Mazda Lamp with gas-filled globe, $3\frac{3}{4}$ in. diam., with reflector; on support, with 15 feet of extension cable and Hubbel plug | \$10.00 ^{11.25} |
| <i>Destinist</i> | 4459 | 250-watt gas-filled Mazda, bulb only | 3.00 |
| <i>Destinate</i> | 4466 | 400-watt Mazda Lamp with gas-filled globe, $3\frac{3}{4}$ in. diam., with reflector; on support, with 15 feet of extension cable and Hubbel plug | 12.00 ^{13.25} |
| <i>Dancery</i> | 4479 | 400-watt gas-filled Mazda, bulb only | 5.00 |
| <i>Destinably</i> | 4476 | *1000-watt Mazda Lamp with clear, gas-filled globe, 5 in. diam., on support, with glass reflector, 4 feet of extension cable with separable connector and pass through switch | 20.00 |
| <i>Destinable</i> | 4478 | *1000-watt gas-filled Mazda, bulb only | 10.00 |

*On account of its size the 1000-watt lamp can only be used in the large, light-tight model lamp houses.

NOTE:—We can supply 250 or 400-watt lamps with portion of globe silvered, if preferred, at \$1.50 extra.

The reflector and parts for attaching to any model B or C for use with clear globe may be secured at \$1.50.

Acetylene Lamp



Acetylene is a convenient illuminant, as it is easily obtained or prepared and is portable. The illumination is sufficient for work at comparatively short distances. Our lamp has a powerful double jet, mounted in front of our patent, optical mirror of silvered glass, which concentrates and steadies the light, nearly doubling the illumination. For the best result obtainable with this lamp a 10-inch focus projection lens, of $\frac{5}{16}$ -inch diameter, giving

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an image 6 feet wide at a distance of 20 feet, should be used. This burner consumes $1\frac{1}{2}$ cubic feet of gas per hour.

| Code Word | Cat. No. | Specifications | Price |
|--------------|-------------|--|---------------|
| <i>Dwarf</i> | 4467 | Acetylene Lamp with reflector and 6 feet of rubber tubing | \$8.00 |

Oxyhydrogen Burner

The oxyhydrogen burner gives greater illumination than the acetylene, but is also somewhat more expensive to operate. Formerly a lime which had to be revolved was employed. In this new burner a pastil of special composition is used, producing a very white and satisfactory light.

| Code Word | Cat. No. | Specifications | Price |
|-------------|-------------|--|----------------|
| <i>Dyad</i> | 4486 | Oxyhydrogen Lamp on support with pastil, interchangeable with the support of our hand-feed arc lamp | \$10.00 |

Rheostats



Figure 1— $4\frac{1}{2}$ -Ampere Rheostat,
No. 4452.

We construct our rheostats to meet the strictest requirements of fireboards and underwriters and they have been approved by the National Board of Fire Underwriters' Laboratory of Chicago. The wire in the resistance coils has practically no temperature coefficient and will not deteriorate with frequent heating and

cooling. The cases are of perforated metal thus providing for the freest possible air circulation among the coils. There are no exposed contact points, and every means of insuring safety has been taken advantage of.

The coils in rheostats of 15 amperes capacity and over are wound on asbestos board strips to prevent sagging or possible contact between coils. The coils in the $4\frac{1}{2}$ -ampere rheostats are carried on porcelain spools.

The $4\frac{1}{2}$ -ampere rheostats can be used satisfactorily with the electric wiring usually found in private houses, connecting with the ordinary lamp socket. Those of higher capacity generally require special wiring.

When ordering be sure to specify voltage.

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Figure 2—15-Ampere Rheostat, No. 4450.

Figure 3—15 to 35-Ampere Rheostat, No. 4456.

| Code Word | Cat. No. | Specifications | Price |
|-------------------|--------------|--|----------------|
| <i>Declension</i> | 4450 | Fixed Form , 15 amperes, 110 volts . . . | \$ 7.00 |
| <i>Decoct</i> | 4451 | “ “ 15 amperes, 220 volts . . . | 18.00 |
| <i>Decore</i> | 4452 | “ “ 4½ amperes, 110 volts, with cord, plug and pass through switch . . . | 5.00 |
| <i>Decoy</i> | 4453 | Fixed Form , 4½ amperes, 220 volts with cord, plug and pass through switch . . . | 7.00 |
| <i>Dearth</i> | 4453A | Fixed Form , 4½ amperes, 110 and 220 volts, with cord, plug and pass through switch . . . | 8.00 |
| <i>Deasil</i> | 4458 | Adjustable Form , 5-10 and 15 amperes, 110 volts . . . | 12.00 |
| <i>Decree</i> | 4454 | “ “ 15 to 25 amperes, 110 volts . . . | 18.00 |
| <i>Decuman</i> | 4455 | “ “ 15 to 25 amperes, 220 volts . . . | 25.00 |
| <i>Duty</i> | 4456 | “ “ 15 to 35 amperes, 110 volts . . . | 27.00 |
| <i>Designer</i> | 4460 | “ “ 15 to 35 amperes, 220 volts . . . | 32.50 |

Resistance for Mazda Lamp on 220 Volts

When the Mazda stereopticon lamps, which are of the 110-115 volt type, are to be used on a 220-volt circuit, a resistance must be introduced in series with the lamp. The proper resistance for the various wattages are listed below.

| Code Word | Cat. No. | Specifications | Price |
|---------------------|-------------|--|----------------|
| <i>Desolateness</i> | 4494 | 220-Volt Resistance for 250-watt lamp . . . | \$ 5.00 |
| <i>Desolater</i> | 4496 | “ “ “ “ 400-watt lamp . . . | 6.50 |
| <i>Desolation</i> | 4498 | “ “ “ “ 1000-watt lamp . . . | 12.00 |

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Switches, Wire and Fuses

All supply wires and fuses, of course, should have a carrying capacity conforming to the rheostat employed.

| Code Word | Cat. No. | Specifications | Price |
|---------------|-------------|---|---------------|
| <i>Daisy</i> | 5168 | Enclosed Knife Switch with 3 sections of wire for connecting with rheostat and lamp | \$5.00 |
| <i>Dunny</i> | 5176 | Approved Cartridge Fuses for 30 amperes, each . | .25 |
| <i>Dargue</i> | 5177 | Approved Cartridge Fuses for 40 amperes, each . | .45 |
| <i>Dynomy</i> | 5184 | No. 14 Rubber Covered Portable Lamp Cord, for 10 amperes, per foot | .04 |
| <i>Dunker</i> | 5179 | Rubber Covered Twin Cable with No. 12 copper wire for 15 amperes, per foot | .10 |
| <i>Duke</i> | 5180 | Rubber Covered Twin Cable with No. 10 copper wire for 25 amperes, per foot | .10 |
| <i>Dulia</i> | 5182 | Rubber Covered Twin Cable with No. 8 copper wire for 35 amperes, per foot | .12½ |

Carbons

| Code Word | Cat. No. | Specifications | Price per 10 |
|---------------|-------------|--|---------------|
| <i>Defy</i> | 4474 | Cored Carbons, $\frac{3}{8}$ -inch diameter, 6 inches long . | \$0.60 |
| <i>Defix</i> | 4470 | " " $\frac{9}{16}$ " " 6 " " . | .40 |
| <i>Defray</i> | 4471 | " " $\frac{5}{16}$ " " 6 " " . | .38 |
| <i>Defi</i> | 4472 | " " $\frac{9}{16}$ " " 6 " " . | .40 |
| <i>Dege</i> | 4473 | " " $\frac{3}{4}$ " " 6 " " . | .38 |

Acetylene Tanks and Generator

| Code Word | Cat. No. | Specifications | Price |
|-----------------|-------------|--------------------------------------|----------------|
| <i>Despect</i> | 4483 | 10 cubic feet capacity net | \$ 8.50 |
| <i>Despeche</i> | 4447 | 30 " " " " net | 15.00 |
| <i>Despight</i> | 4448 | 40 " " " " net | 18.00 |
| <i>Deckle</i> | 4485 | "Acetyjur" Generator | 12.00 |

Oxyhydrogen Generator

This generator is very simple to operate. Oxone and ether are used producing oxygen and hydrogen which are mixed in the mixing chamber of the burner.

| Code Word | Cat. No. | Specifications | Price |
|----------------|-------------|--|----------------|
| <i>Dunnage</i> | 4491 | Economic Oxyhydrogen Generator | \$13.00 |

Large Projection Microscopes Horizontal Type

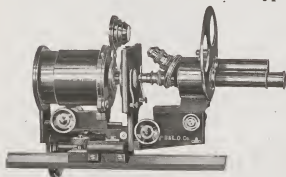


Figure 1—Large Projection Microscope,
Horizontal Type.

Our **Large Projection Microscope** of the regular **Horizontal Type**, Figure 1, is carried on a swinging arm, as it has been in the past, so that quick interchange can be made between microscopical projection and that of lantern slides.

The **Substage Condensers**—three in number—are adjustable for focus by rack and pinion.

A condenser, 72 mm in diameter, is supplied for use with low power objectives, such as the 72, 48 and 32 mm Micro-Tessars. The 72 mm condenser works equally well with all three of these objectives, when the focal point is adjusted to meet a change of powers.

For higher powers the instrument is equipped with two condensers of 0.50 and 0.85 N. A., respectively, the former for 16 and 8 mm objectives, the latter for 4 mm and shorter focus objectives. These two condensers are used in conjunction with the 72 mm condenser. They are mounted on a **revolving nosepiece** which can be swung to one side, thus giving quick interchange or permitting both to be turned away from the optical axis.

The **stage** of the microscope is provided with a U-shaped plate in which is inserted a water cell with an opening of 24 mm. This water cell is flush with the stage surface and consequently comes into direct contact with the slide, which it cools by absorption, thus allowing one to leave seasoned slides in position for any length of time without danger of melting the mounting medium.

If desired, this water cell can be used with all objectives, from the 72 mm Micro-Tessar to the 3 mm objectives, although the opening is not large enough to permit the entire available field of the 32, 48 and 72 mm Micro-Tessars to be utilized. For this reason we supply a second U-shaped plate with aperture of 54 mm, which can be substituted for the other. This latter plate is, of course, without water cell, since none is required with low powers as the image of the arc does not fall near the object.

The **objectives** are mounted on a regular **triple nosepiece** when the equipment consists of the usual microscope objectives, such as the 32, 16 and 8 mm; but if lower powers, such as the 48 and 72 mm Micro-Tessars, are to be used, we recommend that the microscope be equipped with the large revolving plate as shown in Figures 2 and 3, permitting **instant interchange of six different objectives**.

The **body tube** is of large diameter (63 mm inside) to allow for the projection of the full available field of the Micro-Tessars. Fitted to the outer end of the body tube is a revolving plate with two extension tubes for eyepieces and two other openings, the latter being 63 mm in diameter. In projecting with the Micro-Tessar lenses the eyepiece should be turned aside and the light allowed to pass

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through one of these large openings. The other opening is provided so that a mirror can be mounted on the plate for directing the light to the screen when using the vertical microscope, Figure 3, or when it is desired to direct the beam of light onto a drawing board. This mirror is used in connection with the Micro-Tessars only.

The microscope is focused approximately by rack and pinion; fine focusing is accomplished by a side fine adjustment of our lever type, which eliminates any possibility of lost motion.

| Code Word | Cat. No. | Specifications | Price |
|----------------|-------------|--|-----------------|
| <i>Duper</i> | 4138 | Large Projection Microscope, Horizontal Type, as described, including projection eyepiece (3 \times), substage water cell, three substage condensers and triple revolving nosepiece; mounted on swinging arm, without projection lens or objective | \$100.00 |
| <i>Dungeon</i> | 4139 | Same as No. 4138, but with 32, 16 and 8 mm objectives | 117.00 |
| <i>Dunter</i> | 4140 | Same as No. 4139, but with large revolving plate to accommodate six objectives | 129.00 |

Combined Horizontal and Vertical Type

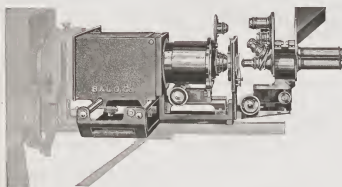


Figure 2—Large Projection Microscope, Combined Horizontal and Vertical Type, in Horizontal Position.

To supply an apparatus with which microscopic objects can be projected while being held in a horizontal plane we have designed this new type of our Large Projection

Microscope. Thus objects in liquid or substances in a more or less liquid state can be projected with the microscope in the vertical position, while objects which do not have to be held in a horizontal plane can be projected with the instrument swung into its horizontal position.

The microscope itself is the same instrument as the one described under the Horizontal Type, but is mounted in connection with a small dark chamber. When the microscope is in the horizontal position, the light passes straight through this dark chamber to the microscope, Figure 2, but when the instrument is swung into the vertical position it draws out of the dark chamber the prism-shaped box upon which it stands, Figure 3.

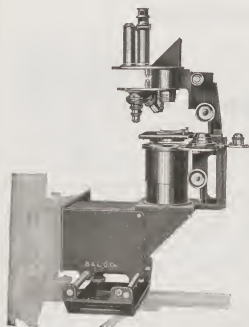


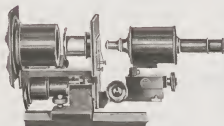
Figure 3—Large Projection Microscope, Combined Horizontal and Vertical Type, in Vertical Position.

prism over the eyepiece takes the place of the first surface mirror. The prism is so mounted that it can be quickly swung out of the path of light when the instrument is returned to the horizontal position. The eyepieces with prism and first surface mirror are all carried on a revolving plate for quick interchange, as described under the Horizontal Type.

The Combined Horizontal and Vertical Type of microscope is carried on two lateral rods which are fastened to a frame and rigidly clamped to the optical bed in front of the slide carrier support. A projection lens with adapter is also mounted on the two lateral rods side by side with the microscope attachment. The projection of microscope slides or lantern slides is accomplished by sliding one or the other attachment into position.

| Code Word | Cat. No. | Specifications | Price |
|------------------|-------------|---|-----------------|
| <i>Dunstable</i> | 4144 | Large Projection Microscope, Combined Horizontal and Vertical Type , as described, with projection eyepiece (3 \times), substage water cell, three substage condensers, revolving plate and nosepiece for six objectives (no objectives), reversing mirror for low power objectives and a prism for use over eyepiece | \$160.00 |
| <i>Dunstical</i> | 4145 | No. 4144, but with 32, 16 and 8 mm objectives | 177.00 |
| <i>Dunsted</i> | 4146 | No. 4144, but with 72, 48 and 32 mm Micro-Tessar, and 16, 8 and 4 mm achromatic objectives | 265.00 |

Medium Microscope



This is a compound microscope designed for use with our Model D, Universal and Convertible Balopticons. It has coarse and fine focusing adjustments, the former by diagonally cut rack and pinion with a long range and the latter by our lever type of adjustment. The stage measures $4\frac{1}{2} \times 3\frac{3}{8}$

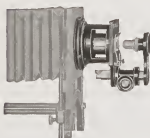
inches and gives a distance of $3\frac{1}{2}$ inches from its center to the base of the arm. It has a substage condenser with iris diaphragm, mounted in a threaded sleeve for focusing. A substage water cell can be fitted at extra cost as indicated in the price list. For use on the Universal Balopticon, the microscope is supplied in addition with a $4\frac{3}{8}$ -inch diameter condensing lens which utilizes the beam from the large projection lens.

Low power objectives, as well as high power, can be used on this microscope without eyepiece. The eyepiece tube is removable and the body tube is $2\frac{1}{2}$ inches in diameter, so that the entire available field of the Micro-Tessars is utilized. The instrument is finished in dull black.

The microscope is mounted on a swinging arm by which it may be thrown out of the optical axis and permitting instantaneous interchange between microscopical and other forms of projection. In the case of the Convertible and Model D Balopticons, the microscope and lantern slide projection lens are mounted on this arm **parfocally**, so that one is swung out of the optical axis and the other swung in by the same movement, no adjustment of the light source or condensers being necessary.

| Code Word | Cat. No. | Specifications | Price |
|-----------------|--------------|--|----------------|
| <i>Daisy</i> | 4250U | Medium Microscope for Universal Balopticon, including projection eyepiece (3X), substage condenser mounted on swinging arm; without objectives (optical bed No. 4141 must be ordered with this microscope) | \$45.00 |
| <i>Dagonet</i> | 4250A | Same as above, but for Model D and Convertible Balopticons | 45.00 |
| <i>Daker</i> | 4260 | Substage Water Cell for medium microscope | 5.00 |
| <i>Durative</i> | 4141 | Optical Bed, carefully planed, 15-in. long; attaches easily to front end of base of Universal Balopticon to accommodate microscope | 5.00 |

Simple Microscope



This is an efficient instrument for elementary work and is designed especially for the Model C Balopticon. It is intended for objectives of low power and has no eyepiece. The substage accordingly is fitted with a condenser for low power objectives, and the focusing adjustment is by diagonally cut rack and pinion only. The stage measures 90 x 80 mm and gives a distance of 42 mm from its center to the arm. The instrument

is interchangeable with the projection lens and is finished in dull black to avoid reflections.

| Code Word | Cat. No. | Specifications | Price |
|---------------|-------------|--|----------------|
| <i>Durity</i> | 4375 | Projection Microscope for use on Model C, including substage condenser and 3 diaphragms for use in the slide carrier; no objective. | \$15.00 |

Micro-Tessar Objectives

The Micro-Tessars are constructed especially for projection and photomicrographic purposes after the formulæ of the Tessar photographic anastigmats, and are capable of projecting a field approximately equal in diameter to their focal length. They are particularly desirable for projecting large sections.

| Code Word | Cat. No. | Equivalent Focus | | Price |
|---------------|-------------|------------------|-----------------|----------------|
| | | mm | in. | |
| <i>Dander</i> | 4401 | 72 | 2 $\frac{7}{8}$ | \$32.00 |
| <i>Dane</i> | 4402 | 48 | 2 | 26.00 |
| <i>Dangle</i> | 4403 | 32 | 1 $\frac{1}{2}$ | 26.00 |

Achromatic Objectives

The regular achromatic microscope objectives are recommended for powers of 16 mm e. f. and higher. These lenses are supplied in blackened mounts.

| Code Word | Cat. No. | Equivalent Focus | | Price |
|----------------|-------------|------------------|-----------------|---------------|
| | | mm | in. | |
| <i>Aubade</i> | 1009 | 32 | 1 $\frac{1}{2}$ | \$4.00 |
| <i>Aubin</i> | 1021 | 16 | $\frac{3}{4}$ | 5.00 |
| <i>Auctary</i> | 1027 | 8 | $\frac{1}{2}$ | 8.00 |
| <i>Audit</i> | 1029 | 4 | $\frac{1}{4}$ | 8.00 |
| <i>Augite</i> | 1035 | 3 | $\frac{1}{8}$ | 8.00 |

Projection Eyepieces



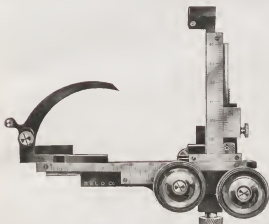
Our projection eyepieces are of **achromatic** construction and project an image superior in every way to those given by ordinary eyepieces. We recommend for use with the 16 mm objective and all higher powers.

| Code Word | Cat. No. | Specifications | Price |
|----------------|-------------|-------------------------|---------------|
| <i>Deist</i> | 4400 | Projection Eyepiece, 3× | \$7.50 |
| <i>Daalder</i> | 4405 | Projection Eyepiece, 5× | 7.50 |

Reflecting Prism

| Code Word | Cat. No. | Specifications | Price |
|----------------|-------------|--|---------------|
| <i>Calyptu</i> | 4551 | Reflecting Prism, in mount fitting eyepiece tube | \$7.50 |

Attachable Mechanical Stage



The mechanical stage enables one to examine a slide area conveniently and accurately and to permanently locate special areas by means of the scale readings.

The model offered attaches to the corners of any square microscope stage by means of an adjustable clamp. The movements are by rack and pinion, the adjustment heads being close together in fixed relative position. One scale reads 75 mm and the other 55 mm, the range available

being dependent upon the size of the microscope stage. The scales of both movements are graduated in single millimeters with verniers reading to tenths. The main parts are lacquered black to avoid reflections. The scales are engraved on fine German silver.

| Code Word | Cat. No. | Specifications | Price |
|--------------|-------------|--------------------------------|----------------|
| <i>Amber</i> | 2116 | Mechanical Stage, as described | \$16.00 |

Microscope Accessories for Polarized Light

For the projection of petrographical specimens, crystals, etc., we have designed a set of accessories for projection with either parallel or convergent polarized light. The accessories can be used with either the Horizontal or Combined Horizontal and Vertical Type of our Large Projection Microscope. This set of accessories is made up of the following:—

Nicol prism polarizer in mounting to fit on the back of the substage condenser, and so mounted that there is **no danger of overheating** by the arc.

Nicol prism analyzer in rotating mount which clamps over eyepiece of microscope and which can be thrown in or out of the optical axis. The mounting is provided with a slot for insertion of selenite plates, quartz wedges, etc.

Supplementary draw tube which is attached to the revolving plate in place of one of the eyepiece adapters. This tube is required in the projection of interference figures to bring the Bertrand lens into correct position.

48 mm achromatic objective which is attached to above draw tube and serves as Bertrand lens in projection of interference figures.

Substage condenser of high numerical aperture to be mounted on substage nosepiece in place of small condenser for projection of interference figures. An objective of correspondingly high numerical aperture, such as a 4 mm, must be used in this work.

Circular revolving stage on plate to fit in microscope stage in place of plate carrying water cell.

| Code Word | Cat. No. | Specifications | Price |
|------------------|-------------|---|----------------|
| <i>Daan</i> | 4121 | Nicol Prism Polarizer in mounting to fit on back of substage condenser | \$15.00 |
| <i>Dabl</i> | 4123 | Nicol Prism Analyzer in rotating mount with clamp to fit over eyepiece; mounting is provided with slot for inserting quartz wedge, selenite plates, etc.; mounting carrying nicol prism can be swung out of optical axis, if desired | |
| <i>Daboia</i> | 4125 | Supplementary Draw Tube for Bertrand lens | 15.00 |
| <i>Dabber</i> | 4127 | Substage Condenser of high numerical aperture for projection of interference figures | 3.00 |
| <i>Atypic</i> | 1005 | 48 mm objective for use as Bertrand lens; used on supplementary draw tube for projection of interference figures | 5.00 |
| <i>Dumpish</i> | 4143 | Plain Circular Revolving Stage on plate fitting in place of plate carrying water cell | 4.00 |
| <i>Antefixa</i> | 1500 | Selenite Plate , Red of 1st. Order | 15.00 |
| <i>Antegrade</i> | 1502 | Quartz Wedge , Order I-III | 2.50 |
| <i>Antelega</i> | 1504 | Quarter Undulation Mica Plate | 5.50 |
| | | | 2.25 |

Vertical Attachments

We provide several of these attachments for use with our different Balopticons. They afford a number of projection possibilities, permitting one to project large transparencies, liquids and other similar objects which must be placed in a horizontal position.

The beam of light in each attachment is directed into a vertical course by a mirror placed at an angle of 45° within a dark chamber. A plano-convex condensing lens is placed in a horizontal mounting on the top of this dark chamber. It serves as a stage upon which to work and focuses the light in the field of the vertical projection lens, which is carried upon an upright support or bed. A mirror above the projection lens directs the image toward the screen. The different attachments and the Balopticons for which they are designed are indicated in the price list below.

| Code Word | Cat. No. | Specifications | Price |
|----------------|--------------|--|----------------|
| <i>Drumlin</i> | 4376 | Vertical Attachment for Model C Balopticon, as described and illustrated, page 33 | \$10.00 |
| <i>Dale</i> | 4290 | Vertical Attachment for Model D or Convertible Balopticon, with prism shaped mirror box and stationary mirror, as described and illustrated, page 43 | 15.00 |
| <i>Dipody</i> | 4136B | Vertical Attachment for Model D Balopticon with front standard, and $1\frac{5}{8}$ -inch diameter, 10 in. focus projection lens, as described and illustrated, page 43 | 42.00 |
| <i>Ditty</i> | 4136C | Vertical Attachment for Convertible Balopticon, as described and illustrated, page 76, consisting of dark chamber with two supports, adjustable interior mirror and sliding plate carrying $4\frac{13}{32}$ in. diam. condenser in mount, $1\frac{5}{8}$ -in. diam., 10-in. focus, projection lens with reversing mirror on vertical rod, permitting latter to be moved out of path of light from opaque projection lens. Accessories for projection of polarized light can be readily added | 47.50 |
| <i>Dirl</i> | 4142 | Special Vertical Attachment for Convertible Balopticon, as described and illustrated, page 74, consisting of dark chamber with interior adjustable mirror, 8-in. diam. condenser, 15-in. focus, $2\frac{7}{16}$ -in. diam. projection lens on vertical support with swinging arm so lens can be swung out of path of light from opaque projection lens | 50.00 |

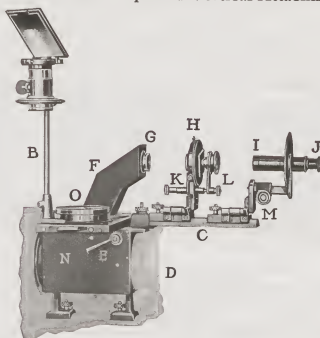
Attachments for Projecting Opaque Objects

The attachments for projecting opaque objects with the Models C and D Balopticons are listed herewith. These attachments are described and illustrated under the respective lanterns for which they are designed.

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| Code Word | Cat. No. | Specifications | Price |
|------------------|-------------|---|----------------|
| <i>Dusk</i> | 5080 | Attachment for projecting opaque objects with Model C Balopticon, with $2\frac{5}{16}$ -in. diam., 12-in. focus lens and reversing mirror | \$35.00 |
| <i>Dumose</i> | 5082 | No. 5080 but with 4-in. diam., 15-in. focus lens | 67.00 |
| <i>Durham</i> | 5084 | No. 5080, 4-in. diam., 18-in. focus lens | 67.00 |
| <i>Duffel</i> | 4261 | Attachment for projecting opaque objects with Model D Balopticon, with $2\frac{5}{16}$ in. diam., 12-in. focus lens and reversing mirror | 33.00 |
| <i>Dulcimer</i> | 4263 | No. 4261, but with 4-in. diam., 15-in. focus lens | 65.00 |
| <i>Dufrenite</i> | 4264 | No. 4261, but with 4-in. diam., 18-in. focus lens | 65.00 |

Combined Polariscope and Vertical Attachment



We have designed this attachment to provide for a quick interchange from polariscopic to other forms of projection with the convenience characteristic of all of our projection apparatus. It permits practically instantaneous interchange between polariscopic, vertical and all other forms of projection.

The attachment consists of a dark chamber, A, supported on the optical bed by two standards. The top of this dark chamber is fitted with a sliding plate upon which the vertical attachment, for projecting horizontally placed transparencies, and the polarizer are mounted side by side.

The front of the chamber is provided with a plano-convex condensing lens and a slide carrier box, D, as well as means for attaching the bellows. Within the

chamber is a swinging mirror which catches in any one of three positions as may be required for the method of projection being employed. The mirror is operated by a lever, E, at either side.

Upon the slide on top of the dark chamber a Delezenne polarizer, F, is mounted in a metal box, on the front of which the quarter-wave mica plates for rotating the polarized beam are located at G. The size of the beam of light available with this accurately constructed Delezenne polarizer is very large and of exceptional brilliancy, excelling that obtained with any other than very large and expensive nicol prisms. It illuminates an ample field.

The stage, H, for objects, the objective, I, and analyzer, J, are mounted on supports, which are adjustable along the horizontal bed. The stage is 95 mm in diameter, is revolvable and has centering screws. It may also be removed and a revolving mechanical stage, furnished at an extra cost, substituted. Between the polarizer and the stage is the mounting, K, for a highly convergent lens, while a similar mounting, L, is provided on the front of the stage for a highly divergent lens which is supplied with an iris diaphragm for controlling the size of the transmitted beam. These lenses are used when projecting with convergent polarized light, as in work with interference figures. The mountings include quick acting screws, which enable the operator to turn either or both lenses out of the optical axis, when parallel polarized light is desired, and to focus.

The objective is of 4-inch focus and, with a nicol prism, approximately 12 mm, is held in a tube which slides in a main tube. This in turn is mounted with a standard rack and pinion adjustment, M, thus affording a wide range for focusing. The analyzer may be revolved.

This polariscope, giving a large, clear field upon the screen, offers means for extensively demonstrating the properties of parallel and convergent polarized light, with rock sections, crystals, etc.

For vertical work it is only necessary to slide the plate over until the vertical attachment is in line with the opening in the roof of the dark chamber. The sliding plate is moved by means of the handle, N, and a stop insures its being brought into exact alignment. The interior mirror of the dark chamber must also be lowered to its first or 45° position, to direct a beam of light directly upwards.

The vertical attachment consists of a plano-convex condenser, O, which is mounted in the sliding plate with the plane side up, and thus serves also for a stage, 4½ inches in diameter, upon which the glass dishes, specimens, etc., to be projected, are placed. At one corner of the sliding plate is a vertical rod, B, which carries the projection lens and mirror by which the beam of light is directed to the screen.

When projecting opaque objects the vertical attachment is withdrawn from the path of the large projection lens by means of the sliding plate, and the supports carrying the body tube and revolving stage of the polariscope are hinged so that they, too, can be turned away from the path of light. When projecting lantern slides or microscopic specimens the interior mirror is raised to its third position to

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permit the passage of the parallel beam of light straight through the dark chamber to the accessories for lantern slide or microscopical projection which are mounted on the optical bed in front of the dark chamber. This attachment, as described, is designed for use on the Convertible and Model D Balopticons.

| Code Word | Cat. No. | Specifications | Price |
|-----------------|--------------|---|-----------------|
| <i>Darkling</i> | 5525 | Combined Polariscope and Vertical Attachment for the Convertible or Model D Balopticon, as described and illustrated | \$175.00 |
| <i>Dakotas</i> | 5530 | Polariscope Attachment for Universal Balopticon as described, or for use with vertical attachment No. 4136 (dark chamber in either case should be returned to us for fitting) | 130.00 |
| <i>Dartrous</i> | 5525P | Polariscope Attachment only | 160.00 |

Apparatus for Projection of the Spectrum and Complementary Colors

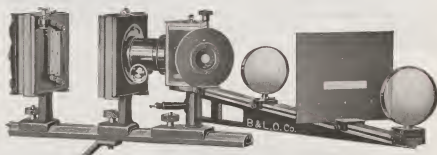


Figure 1—Showing Attachment Set Up on Either Model D or Convertible Balopticon.

The projection of the spectrum and complementary colors is desirable in practically every physical or chemical department. We have designed for this work a set of accessories consisting of a supplementary bed attachable to any of our Balopticons fitted with the optical bed, an adjustable slit, carbon bisulphide prism and a set of lenses so that either the spectrum or complementary colors can be projected, as desired.

Both absorption and emission spectra can be shown with this attachment, the former being demonstrated by simply placing the absorbing media in the path of light in the front of the slit, while the latter is shown by introducing various chemical salts into the arc.

When projecting the spectrum, the adjustable slit shown at the extreme left, Figure 1, is clamped to the optical bed of the Balopticon in front of the slide carrier. The projection lens of the lantern, which should have a focal length of not more than 8 or 10 inches, is mounted in front of the slit. The other accessories are carried on the supplementary bed, which is attached to the lantern bed. These accessories consists of a 60° bottle prism, which is filled with carbon bisulphide

the iris diaphragm, which limits the area on the screen when projecting complementary colors; the first lens which images the diaphragm upon the screen and also forms a small image of the spectrum in the plane of the slit on the vertical stage; vertical stage with horizontal slit and clips at the back for holding small refracting wedges; the second lens in hinged mount which projects a magnified image of the spectrum on the screen.

For projecting complementary colors the vertical stage, Figure 2, has a vertical and cross slide with clips for holding small deflecting prisms, of which three are supplied of varying widths. By placing one of the deflecting prisms on this slide and moving it to any desired point a portion of the spectrum will be deflected, and there will be two images of the opening of the iris diaphragm upon the screen.

One will represent that portion of the spectrum deflected by the prism, and the other will represent the remainder of the spectrum which passes through to the screen without refraction. Where the two circles overlap there will be clear, white light. This prism can be moved horizontally through the entire spectrum, deflecting any portion that may be desired.

By putting in two prisms with the bases in opposite directions—that is, one facing downward and the other upward—three circles can be seen upon the screen.

When showing complementary colors, the lens at the end of the supplementary bed should be turned out of the optical axis, the lens mount being hinged for this purpose. By turning this lens **into the optical axis** one can determine exactly what portion of the spectrum will be deflected by the prism.

If one wishes to project absorption and emission spectra only, this can be done with the adjustable slit and the bottle prism, as indicated in the price list.

Special Carbon Holders for Projecting Spectra of Chemical Salts

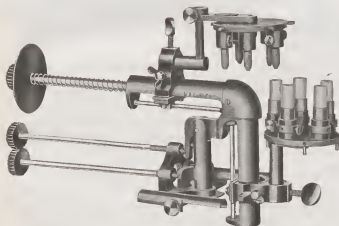


Figure 2—Arc Lamp Showing Revolving Electrode Plates.

The spectra of chemical salts are projected by introducing the salt into the arc. If a pure spectrum is to be obtained the carbons must be changed with each new salt, but as this cannot be done conveniently with the ordinary lamp, we have devised a pair of special carbon

holders with revolving electrode plates, which are attached to the lamp, as illustrated in Figure 2. There are five pairs of electrodes and the lower carbons are fitted with quartz cups in which the salts are placed. Thus a different cup is provided for each salt and the upper carbon changed, as well. The vapor of the salt becomes the light source and the characteristic spectrum, just as seen in the spectrocope, is projected on the screen.

Spectral Tube Holder for Projecting Spectra of Gases

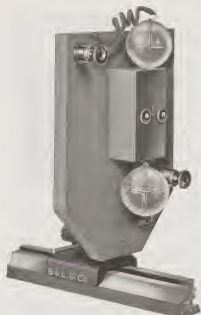


Figure 3

*P. G. Nutting, *Bulletin of the Bureau of Standards*, Vol. IV, p. 511.

To show the spectra of gaseous elements it is necessary to use the transformer type of spectral tubes* in connection with a high voltage transformer or induction coil. The high voltage necessitates a special asbestos board holder for this tube to insulate it from the rest of the apparatus. The holder is illustrated in Figure 3.

This holder is substituted for the adjustable slit shown at the extreme left in Figure 1. A brass plate, secured to two posts by milled nuts, holds the spectral tube in position. The plate has a slit which fulfills the same function as the adjustable slit in Figure 1. Any good type of transformer or induction coil of about 10,000 volts capacity can be used for this work.

| Code Word | Cat. No. | Specifications | Price |
|--------------------|--------------|--|----------------|
| <i>Daffodil</i> | 4154 | Set of accessories for projection of the spectrum and complementary colors, with Model D and Convertible Balopticons, consisting of supplementary optical bed, adjustable slit and standard, carbon bisulphide prism, lenses, etc. | \$45.00 |
| <i>Daffodiller</i> | 4154U | Set of Accessories for projection of the spectrum and complementary colors, with Universal Balopticon, consisting of condensing lens in mount to fit front of dark chamber, supplementary optical bed, adjustable slit and standard, and front standard and front board with flange; carbon bisulphide prism, lenses, etc. | 50.00 |
| <i>Daffish</i> | 4156 | Pair of Special Carbon Holders with revolving plates carrying special electrodes for holding chemical salts | 15.00 |
| <i>Dandli</i> | 4157 | Spectral Tube Holder for projecting spectra of gases (The following set of accessories is for projection of the spectrum only) | 10.00 |
| <i>Daff</i> | 4150 | Adjustable Slit | 7.50 |
| <i>Dudeen</i> | 4137 | Standard for supporting the above | 3.00 |
| <i>Deliberate</i> | 4446 | Bottle Prism (for carbon bisulphide); width of face, 60 mm; height, 90 mm | 6.00 |
| <i>Demy</i> | 4285 | Prism Support for the above | 3.00 |

Adjustable Slit

An adjustable slit is an indispensable attachment in spectrum experiments with light. We furnish the adjustable slit mounted on a blackened metal front board, which may be attached to the standard in such a way as to make the slit horizontal or vertical, as desired.

The plates of the slit, which are of German silver, with edges carefully ground and polished, form two sides of a parallelogram. They are adjustable by means of a micrometer screw, with a pitch of .5 mm, and a spring, producing a very gradual movement. All the bearings and fittings, as well as the edges, are precisely made, giving unusually high grade results whenever this slit is used.



| Code Word | Cat. No. | Specifications | Price |
|-------------|-------------|---|---------------|
| <i>Daff</i> | 4150 | Adjustable Slit, as described above . . . | \$7.50 |

Prisms

| Code Word | Cat. No. | Specifications | Price |
|-------------------|-------------|--|----------------|
| <i>Deline</i> | 4442 | Flint Glass Prism, 60°, 1½-inch face . . . | \$ 7.50 |
| <i>Despond</i> | 4443 | Flint Glass Prism, 60°, 2-inch face . . . | 13.50 |
| <i>Deliberate</i> | 4446 | Bottle Prism, of crystal glass; width of face, 60 mm; height, 90 mm; accurately ground glass stopper . . | 6.00 |
| <i>Decide</i> | 4441 | Trapezoidal Erecting Prism, in mount to fit over 1½-in. diameter lens . . . | 20.00 |

Prism Support



This is a convenience in experiments with light, affording a support for the different prisms, etc. It has a regular standard with base block and clamp, which attaches directly to the optical bed and may be placed in any convenient position along it. It is of metal throughout. The top is circular, 75 mm in diameter, and is adjustable for height, a convenient clamping screw securing it in any desired position.

| Code Word | Cat. No. | Specifications | Price |
|-------------|-------------|--|---------------|
| <i>Demy</i> | 4285 | Prism Support, as described, for Model D, Universal or Convertible Balopticons . . . | \$3.00 |

Slide Carriers



Figure 1—Rapid-Changing Slide Carrier, No. 4449.

A satisfactory slide carrier, both convenient and durable, is essential to a high grade projection apparatus. We supply several which have given such satisfaction. Particular attention is called to **No. 4449**, our new **rapid-changing slide carrier**, which is a double carrier operated entirely from one side. As a new slide is fed forward, the preceding slide is automatically returned, and a metal shield, which travels with the slide, obliterates all movement of the slide on the screen, so noticeable in ordinary double carriers and other types of slide changers. This approximates a dissolving effect, thereby relieving all eyestrain.

Two carriers, **Nos. 4430 and 4432**, are neatly finished wooden frames, provided with an automatic elevating device. This consists of loosely fitted metal pins beneath the center of the slides, which engage with an inclined plane at the end of the sliding movement, raising the slide so that it may be easily lifted out by its margin. **No. 4430** is regularly supplied with our lantern slide equipments.



Figure 2—Slide Carrier, No. 4430.



Figure 3—Slide Carrier, No. 4435.

An all-metal slide, **No. 4435**, is provided with an automatic centering device, which enables one to use slides of the English dimensions and the Standard American size in the same carrier. The measurements, which are given below, are outside dimensions and should not be confused with the size of the mats. We also make a convenient **post card carrier** for our apparatus projecting opaque objects.

| Code Word | Cat. No. | Specifications | Price |
|----------------|-------------|---|---------------|
| <i>Decapon</i> | 4430 | Slide Carrier, for two $3\frac{1}{4} \times 4$ -inch slides with automatic elevating device | \$1.25 |
| <i>Decalog</i> | 4432 | Double Slide Carrier, for either $3\frac{1}{4} \times 3\frac{1}{4}$ or $3\frac{1}{4} \times 4$ -inch slides with automatic elevating device | 1.75 |
| <i>Decamp</i> | 4435 | Slide Carrier, all metal, with automatic centering device for slides $3\frac{1}{4} \times 3\frac{1}{4}$, $3\frac{1}{4} \times 4$ and $3\frac{1}{4} \times 4\frac{1}{4}$ inches | 3.50 |
| <i>Dunciad</i> | 4449 | Rapid-Changing Slide Carrier | 2.75 |
| <i>Dairy</i> | 5098 | Post Card Carrier, holds cards and prints up to $5\frac{1}{2}$ inches square | 2.00 |
| <i>Dolly</i> | 5099 | Extra Holders for above, each | .75 |

Note—The semi-dissolving slide carrier, No. 4449, may be substituted on any equipment regularly supplied with No. 4430 for \$ 1.50 additional.

Bausch & Lomb Optical Company

Screens

Ordinary sheeting, or common cloth, is too translucent to furnish a satisfactory screen for projection work. Our screens are all made of heavy cloth, specially prepared and as nearly opaque as possible. They are mounted on spring rollers.

| Code Word | Cat. No. | Specifications | Price |
|---------------|-------------|---|----------------|
| <i>Dogzle</i> | 4420 | Screen, 6 feet x 6 feet, each . . . net | \$ 4.00 |
| <i>Deas</i> | 4421 | " 7 " x 7 " " " . . . net | 6.00 |
| <i>Deave</i> | 4422 | " 8 " x 8 " " " . . . net | 7.20 |
| <i>Debar</i> | 4423 | " 9 " x 9 " " " . . . net | 12.00 |
| <i>Debate</i> | 4424 | " 8 " x 10 " " " . . . net | 13.50 |
| <i>Debel</i> | 4425 | " 10 " x 10 " " " . . . net | 15.00 |
| <i>Deea</i> | 4426 | " 12 " x 12 " " " . . . net | 20.00 |

Larger sizes will be quoted upon request.

Aluminum Screens

These screens are made of heavy material with a metallic surface. They give a much more brilliant image than the ordinary screen and are recommended in all cases, but especially will their superiority be noted in projecting opaque objects, microscopic specimens and in all work requiring brilliant illumination. Owing to their narrower field, however, due to the high reflecting surface, they should be used only when the audience can be seated within an included angle of 60 degrees from the center of the screen.

| Code Word | Cat. No. | Size | Price | Code Word | Cat. No. | Size | Price |
|---------------|--------------|-----------|--------------------|-----------------|--------------|-------------|--------------------|
| <i>Demand</i> | 4420A | 6 x 6 ft. | \$10.00 net | <i>Demerine</i> | 4423A | 9 x 9 ft. | \$22.00 net |
| <i>Demark</i> | 4421A | 7 x 7 ft. | 14.00 net | <i>Demigod</i> | 4425A | 10 x 10 ft. | 28.00 net |
| <i>Deme</i> | 4422A | 8 x 8 ft. | 18.00 net | <i>Demit</i> | 4426A | 12 x 12 ft. | 40.00 net |

Sateen Screens

These screens are supplied for portable outfits. Sateen is as nearly opaque and highly reflecting a material as can be obtained, which at the same time is suitable for packing in a case. These screens are provided with eyelets for stretching and have reinforced borders.

| Code Word | Cat. No. | Specifications | Price |
|------------------|--------------|------------------------------|----------------|
| <i>Deacon</i> | 4420S | Screen, 6 x 6 feet . . . net | \$ 3.50 |
| <i>Deaconess</i> | 4423S | " 9 x 9 feet . . . net | 8.50 |
| <i>Deaconry</i> | 4426S | " 12 x 12 feet . . . net | 14.00 |

Screen Cases

In order to provide a suitable casing in which to mount the screen and to protect it from dust we are offering a line of metal cases which are provided with brackets for holding the screen and with metal straps to support the casing.

| Code Word | Cat. No. | Specifications | Price |
|------------------|--------------|-------------------------------------|----------------|
| <i>Damewort</i> | 4420C | For 6 x 6-foot screen net | \$ 6.00 |
| <i>Damiana</i> | 4421C | " 7 x 7-foot " net | 7.00 |
| <i>Damianist</i> | 4422C | " 8 x 8-foot " net | 8.00 |
| <i>Dammar</i> | 4423C | " 9 x 9-foot " net | 9.00 |
| <i>Dammara</i> | 4425C | " 10 x 10-foot " net | 10.00 |
| <i>Damnify</i> | 4426C | " 12 x 12-foot " net | 12.00 |

Balopticon Tables

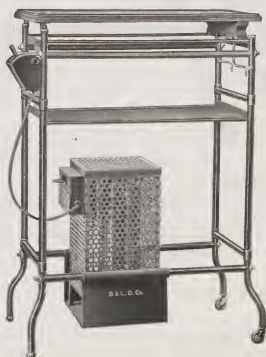


Figure 1—Balopticon Table, No. 4252, with No. 4456 Rheostat
and No. 5168 Knife Switch.

Our stands are constructed for rigidity and durability. They are of a convenient height for operating the lanterns, and also of the proper height for clearing the heads of the audience. The tops are provided at the front with elevating screws operated by small cranks for tilting the lantern. The third stand



Figure 2—Balopticon Table, No. 4253A, with No. 4456 Rheostat
and No. 5168 Knife Switch.

listed has castors on the two legs at the front, the legs at the back serving to keep the apparatus steady. The stand is easily moved by slightly lifting the legs at the back. **No. 4256** is of metal throughout, finished in black enamel. **No. 4253A** has a heavy cast iron base and is provided with castors and leveling screws on all four feet. It is intended for large and heavy apparatus.

| Code Word | Cat. No. | Specifications | Price |
|------------------|--------------|---|----------------|
| <i>Dunce</i> | 4256 | Balopticon Table of metal, top 30 x 14 in. | \$10.00 |
| <i>Dumpy</i> | 4258 | Balopticon Table as above but with shelf for accessories | 12.00 |
| <i>Duel</i> | 4252 | Balopticon Table of metal with wooden top, 32 x 16½ in. | 16.00 |
| <i>Duplicand</i> | 4253A | Balopticon Table with strong cast iron base and frame and heavy 40 x 17-in. wooden top; space beneath for adding cabinet, if desired; provided with castors and leveling screws | 25.00 |
| <i>Duplicate</i> | 4253B | No. 4253A, but with top 46 x 16 in. | 32.50 |

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Other Products

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| Bacteriological Apparatus | Microtomes |
| Centrifuges | Ophthalmic Instruments |
| Engineering Instruments | Ophthalmic Lenses |
| Electric Incubators | Photographic Lenses and Shutters |
| Field Glasses | Photomicrographic Apparatus |
| Haemacytometers | Reading Glasses |
| Laboratory Apparatus | Searchlight Reflectors |
| Magnifiers | |

We shall be glad to furnish literature or information on any of the same upon request.





